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RESEARCH ON HUMAN RELATIONS IN INDUSTRY

GOOD human relations are as important for an industry as efficient machines and production methods. Although the need for making the best possible use of the man power in a factory had been realized for a long time, a proper scientific study of human relations in industry is only of recent origin.

In the eyes of an industrial sociologist, the factory is a social system in itself, with a network of relationships between individuals and groups. The most superficial analysis reveals that these relationships are far more complex than the traditional management-worker antithesis would seem to suggest. Although it may be possible to single out one or more aspects of the relationships for study, all are interdependent to some extent; and it is the recognition of this interdependence which is leading sociologists increasingly to insist that any particular problem of relationships within an organisation must be studied and resolved in terms of the totality of which it forms a part. The interested reader is reffered to two excellent articles on the subject by Dr. W. H. Scott in two issues of *Journal of the Institute of Personnel Management* (1952, 34, Nos. 319 and 321).

After considering the difficulties confronting those who wish to investigate social relationships in industry, Dr. Scott discusses some of the contributions of current systematic studies in this field. Social scientists are concerned to discover the conditions under which high productivity and high morale are most likely to coexist, since under such conditions the satisfaction of the needs of both the individual and the organisation will be at its greatest. Evidence is increasing that fuller opportunities for self-development and a greater measure of self-determination in industry are the basic prerequisites. There is a pressing need for the development of leadership ability and skills at all levels-permissive or consultative, rather than authoritarian, in character.

In a formal organisation, the division of functions among persons or groups of persons and the relationships deemed necessary for their co-ordination are very rigid. But it never quite works in the manner prescribed, owing to the growth of informal relationships which cut across formal lines at all levels. It would be erroneous to regard this informal organisation as unstable or haphazard, for it usually

follows a very definite and persistent pattern, and like all stable relationships, develops characteristic values, norms, beliefs and attitudes which tend to become rooted and resistant to change, and to be binding on the members of the group. In a real sense, therefore, the informal organisation is the one which matters. In conclusion, Dr. Scott suggests that the more the formal and informal organizations can be brought into harmony, the more likelihood there is of achieving a system of social relationships which will be effective both in satisfying individual needs and in attaining common goals.

While the above would indicate the broad outlines of the subject at the research level, it is very encouraging to find that the matter is also receiving adequate attention from quarters which are ultimately responsible for furthering such research projects. In fact, the first report of the Joint Committee on Human Relations in Industry, England, has just been published*. The report includes details of research projects that have been approved and which are now going ahead.

Merely improving conditions of work has not been the first concern of the Committee. The programme of work has been fully discussed with trade unionists and industrialists so that it should be as practical as possible. In every case the Committee has tried to take a broad view of productivity needs because, it believes, "greater human satisfaction in work is both compatible with and essential to increased efficiency and productivity".

A major consideration has been the slow advance of work in the human relations field, so that scientific standards will have to be raised, research methods improved and the general quality of work made more reliable. So far, the practical use to industry of such work has not been put across convincingly. This problem will have to be tackled and industry encouraged to apply the results of research to the maximum.

The main job of the Committee during the year has been the building up of a research programme. Seventy-eight projects were considered by the Committee and twelve of them have already been approved, their estimated cost being about £89,000. Others are still under consideration.

One project, on the effect of incentive payment schemes on productivity, is being carried out by Birmingham University. The experience of factories that have introduced incentive payments will be assembled and analysed, and account will be taken of trade union attitudes and experience. In previous work, the Edinburgh University had found that there was friction between inspection and production departments in some firms, which caused inefficiency. The work now in progress is directed to finding out how the inspection process can best be organised to avoid this.

Factors helping or slowing down technological change are given considerable importance in the Committee's programme. Liverpool University is studying the way in which new production methods and techniques can be absorbed without raising human problems. The research was initiated by a big steel firm, and the Liverpool team is co-operating with researchers in Holland, Germany, Belgium and other countries in order to compare results with them.

The Committee is particularly anxious that the results of the research should be known and acted upon in industry. In view of the difficulties of the latter and also of their possible applicability to industrial problems in our country, the concluding section of the Report is perhaps worth quoting: "In our contacts with people and organisations in industry, we have had our attention repeatedly drawn to the problem of applying research results in the human relations field. This is an especially difficult question in a field where, unlike the natural and medical sciences, there are few trained practitioners in industry, and where the applied research and other institutions exist. We have not yet had time to devote sufficient attention to this matter, but we feel it to be a matter of the utmost importance. As far as immediate action is concerned, the practical results of our research programme would undoubtedly be enhanced if researchers could keep in close touch with organisations able to assist the dissemination to industry of information about the research. For our part, we have under consideration various ways and means of fostering research application such as surveys to summarize available knowledge on subjects of practical importance and special publications of 'industrial' versions of research reports."

In this connection it is encouraging to note that in our country industrial research organisations like the ATIRA have already a social sciences unit attached to them. It is essential that everything should be done to quicken the pace of research on human relations in industry, in view of its bearings on the prosperity and well-being of our country.

* *Human Relations in Industry*—Published by H.M.S.O. for D.S.I.R. and the Medical Research Council, England, Price by post 1 *s.* 1½ *d.*

NEW EXPERIENCES WITH FOLIDOL-E 605, IN THE CONTROL OF RICE STEM-BORERS

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STEM-BORERS are major pests of the rice crop in all rice-growing tracts of the Far East. In India, *Schœnobius incertellus* W., *Scirpophaga innotata* W., *Chilo simplex* B., and *Sesamia inferens* W., have been noted to cause damage to the rice crop, *Schœnobius incertellus* W., being the most serious of them. In Japan, where the stem-borer problem is acute, extensive damage is caused by *Chilo simplex* B.

The control of stem-borers has been a challenge to entomologists engaged in the control of rice pests. The introduction of the synthetic hydrocarbon insecticides raised some hopes, but the efficacy of these insecticides is rather limited as they can be directed only against adult moths and larvæ wandering outside on the leaves. Further, they do not act as ovicides nor can they kill the concealed borer larvæ inside the rice stem or sheath.

In recent years some organo-phosphorous compounds were tried against these pests in Japan and reported to be effective in the control of the stem-borer, *Chilo simplex* B.[2,3] Some of these are known to be systemic in their action (that is, the active ingredient can be absorbed by the plant tissue and translocated to other parts of the plant without causing any injurious effect to the plant itself), but Folidol-E 605 is stated to be capable of penetrating into the leaf-tissue only, which after short time decomposes rapidly into non-poisonous compounds. Reports from Japan have acclaimed Folidol-E 605 spraying as the only solution for combating the menace of rice stem-borer, *Chilo simplex* B.[3]

In order to exploit the penetrative property of Folidol-E 605, a preliminary experiment was laid out and the following treatments were introduced with variety D.I.4

T_1 *Check*: Seeds soaked in water for 24 hours and after sprouting, sown directly in seed-beds. T_2 *Seed Soaking*: Seeds soaked in 0·1 per cent. Folidol-E 605 for 24 hours and after sprouting sown directly in seed-beds. T_3 *Seed Soaking and Irrigation*: Same treatment as in T_2, followed by irrigating the seed-bed (50·3 sq. inches) and the transplanted crop (1,296 sq. inches) with 150 c.c. and 3,000 c.c. of 0·1 per cent. Folidol-E 605 respectively, at weekly intervals till flowering (7 irrigations in the field). Water in the transplanted crop was drained off a day before irrigating with Folidol-E 605. T_4 *Seed Soaking and Spraying*: Same treatment as in T_2, followed by spraying the seed-bed and the transplanted crop with 0·08 per cent. Folidol-E 605 at weekly intervals till flowering.

In all the treatments, seedlings 30 days old were transplanted in singles at 6" spacing in square plots of $3' \times 3'$ in well puddled field in three replications. Bunds were raised to a height of about 6" all round each plot to facilitate irrigation with the insecticide or water. Each plot consisted of 6 rows with 6 plants to a row of which 1 row all round was left as border. The crop was observed every day, and tiller counts of individual plants were taken at weekly intervals. The following observations were made: (*a*) Seed soaking did not affect the germination in any manner; (*b*) Treatments T_3 and T_4 did not inhibit the growth of the seedlings in the nursery. On the contrary, the seedlings were more vigorous in growth. (*c*) There was no marked difference in growth between T_1 and T_2 in the nursery and the field. (*d*) Plants in treatment T_3 in the field were more vigorous, healthier and taller than those in treatment T_4, which in itself was better than T_1 and T_2.

At the time of harvest, counts of healthy earheads, white earheads due to borers, partially chaffy earheads due to borers, healthy and borer attacked non-ear-bearing tillers were taken. Earheads of individual plants were harvested and their weights recorded. The results show: (*a*) The percentage of white earheads is highest in T_1 (54·03) followed by T_2 (38·61). T_4 (20·99) is significantly less with regard to percentage of white earheads than T_1 and T_2 and significantly more than T_3 (1·21), (*b*) The percentage of grain-bearing earheads in T_3 (98·79) is significantly more than in the other three treatments and it is least in T1 (45·97). T_2 (61·39) and T_4 (69·01) are not significantly different from one another. (*c*) T_3 (121·287) gives the highest yield which is significantly superior to the other three treatments followed by T_4 (60·660), T_2 (16·507) and T_1 (8·368). The difference in yield between T_1 and T_2 is not, however, significant (yield expressed in grammes per plot).

It is clear from the above results that neither seed soaking nor spraying alone is effective in controlling the stem-borer. Seed soaking fol-

lowed by irrigation with Folidol-E 605 has given an almost complete control of the stem-borer incidence. Since seed soaking alone was not found to be much effective, irrigating the crop as described above, seems to be the only possible control. By irrigating the plots with Folidol-E 605, the plants seem to have absorbed the active ingredient of Folidol-E 605 into their tissues and thus developed resistance to stem-borer attack. Inducing resistance by this method of sap absorption appears to be more feasible than evolving pest-resistant strains.

In view of the highly toxic nature of the insecticide, it is to be considered whether this method is practicable in the field. It is claimed by the manufacturers that the toxicity of Folidol-E 605 for man and animals is considerably reduced by the use of the special emulsifier and therefore no protective appliances are required while spraying the field. While conducting the experiments described above, no protective appliances were used. The conclusions of Deichmann, Hecht and Wirth[1] in their studies on the "Toxicity of E 605" are summarised below: Folidol-E 605 is toxic to man by contact, ingestion or inhalation. 2·5 c.c. of this liquid is considered toxic through ingestion for a man of 70 kg. It is very improbable that this amount will be swallowed accidentally. In order to run the risk of death by contact with Folidol-E 605, the user should empty nearly the whole content of the bottle of 1 litre on his body and remain for several hours without washing. But in practice, all that can happen is that a few drops of Folidol-E 605 may fall on the fingers of the user and as an elementary precaution, immediate washing is recommended. Mortal danger by inhalation of Folidol-E 605 would only occur if the surrounding air contains more than 1 litre solution per cubic metre of air, and such a concentration is not usual while spraying Folidol-E 605 at the recommended dose. Details regarding the optimum time and dose of irrigations, the quantity required for irrigation, the quality of the straw and grain to find out if the insecticide is absorbed by them and if they are safe for consumption by man and animals, are under investigation.

The authors' grateful thanks are due to Dr. N. Parthasarathy for his interest in the work and critical reading of this note.

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ODOUR AND CHEMICAL CONSTITUTION

AN interesting correlation of odour with the pattern of molecular vibrations in the frequency range below 1,000 cm.$^{-1}$ is suggested by R. H. Write in *Nature* (1954, 173, 831). The Raman effect is at present the most convenient tool for the purpose.

A panel of fifteen observers was used to select sixteen compounds with an odour resembling that of nitrobenzene. Of these compounds, all but one (nitrothiophene) were benzene derivatives, all but one (isocoumarane) had multiple bonds in the side chain conjugated with the ring. Apart from this general similarity of type, the compounds had such varied functional groups as nitro, nitrile, aldehyde, ketone, ester, etc. When the low frequency Raman shifts of these compounds were scrutinized, there was some evidence of a statistically significant correlation between the odour and the pattern of the Raman lines below 800 cm.$^{-1}$

Raman lines below about 1,000 cm.$^{-1}$ appear to depend upon the whole configuration of the molecule more than on the constituent groups. Odour also appears to depend more on the whole configuration of the molecule, so that a correlation of odour with vibration would be more reasonable at low frequencies than at high. Moreover, the Planck formula shows that only normal vibrations with a wave number considerably less than 1,000 cm.$^{-1}$ have a significant possibility of being active at body temperature.

THE CHROMOSOMES OF *OPHIOGLOSSUM RETICULATUM* L.

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MANTON[2] in her pioneering work on the "Problems of Cytology and Evolution in the Pteridophyta" has shown that by a combination of modern cytological technique and the necessary manipulative skill and patience, the chromosomes of this group of plants can be studied and may well yield information of great value to the student of evolution. Taking advantage of the wealth of uninvestigated material of this group available in South India a cytogenetical study of this was started recently.

The purpose of this paper is to draw attention to certain striking observations on the cytology of *Ophioglossum reticulatum* L. The plants used in the study were all collected in the wild condition from four localities in South India and grown in pots in a fern house. The cytological and photographic technique followed were essentially similar to what was adopted by Manton.

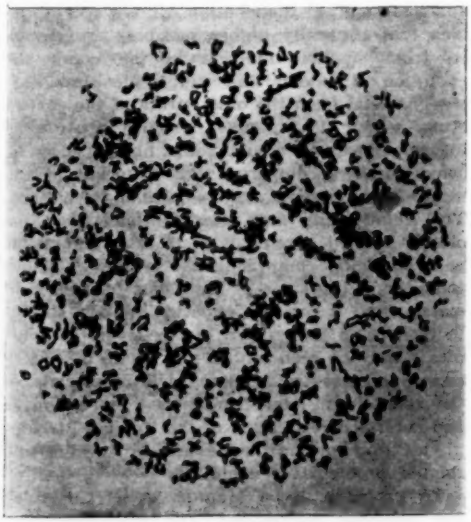

FIG. 1. Photomicrograph showing the first meiotic metaphase chromosomes in *Ophioglossum reticulatum*. (Parambikulam material). There are 631 bivalents and 10 fragments, × 500.

First material (from Trivandrum City, sea coast). The spore mother cells clearly showed 564 bivalents at metaphase of first meiotic division. Count from another plant of the same collection showed 572 bivalents. The difference probably indicates the margin of error to be expected in determinations of such high numbers, though counts were made from very clear preparations and every care was taken to avoid errors.

Second material (from Parambikulam, 200 miles north of Trivandrum, in dense forest at an elevation of about 2,000'). One plant from this collection showed 566 bivalents at first meiotic metaphase, and this count agrees very closely with the first count of 564 bivalents from the Trivandrum material. But count from another plant from the same collection, and from a preparation which was exceptionally clear showed 631 bivalents and what appeared to be 10 fragments (or very small univalents ?) (Figs. 1 and 2). This shows that the somatic cells of the sporophyte of this plant have over 1,260 chromosomes, the highest chromosome number yet discovered in any species. Attempts were made to get a somatic chromosome count from archesporial mitosis, and preparations

FIG. 2. Explanatory diagram of the same metaphase plate shown in Fig. 1, made on enlarged photographic print, and reduced to same size in reproduction.

showing over 1,000 chromosomes in a single cell at metaphase were obtained.

Third material (from Ponmudi hill top, 40 miles north-east of Trivandrum at 4,000' elevation, growing in exposed grassland). The

plants from this locality showed smaller rhizomes, and the sterile part of the sporophyll was a little broader and the apex more rounded compared with specimens from the first two localities. A clear count of 451 bivalents was made in this plant. Also plants from this collection showed the largest chromosomes so far seen in this species.

Fourth material (from Ettapadappu, about 12 miles north-east of Ponmudi, in dense forest at 1,000' elevation). Plants from this area showed 436 bivalents at first metaphase of meiosis, the lowest chromosome number so far encountered in *O. reticulatum*.

In the course of this study we have examined several metaphase plates in preparations made from plants of each of the four localities, and have not so far seen any evidence of multivalent formation. The size of the chromosomes is appreciably large for a cell having such an extraordinarily large number. The spiral structure of the chromosomes is clearly visible in some preparations, and sometimes one component of a bivalent appears longer than its homologue on account of unequal relaxation of the spirals. From comparison of several counts in each material we are inclined to believe that the margin of error in determination of numbers will be under 2 per cent. The observed numbers in *O. reticulatum* from four different localities vary from 436 to 631 bivalents, indicating a range between 872 and 1262 chromosomes in the sporophytic tissue.

Two points deserve consideration in this connection:—(1) the mode of origin of such a large number, and (2) the significance, if any, of the difference in numbers observed in materials of the same species and of closely related species from different geographical regions. A survey of the known chromosome numbers in seed plants[1] shows that higher numbers have evolved from smaller numbers by polyploidy. That more or less the same process has been operative also in the evolution of the lower vascular plants is seen from Manton's observations.[2] That a polyploid series exists in the genus *Ophioglossum* is evident from Manton's record of $n = 128$ in *O. lusitanicum* and $n = 256$ in *O. vulgatum*. Both species showed only bivalents at meiosis, and in the absence of record of any lower numbers in the genus it was difficult to decide the basic number. The present observations show that while *O. vulgatum* from Manchester has a diploid chromosome number of over 500, the Parambikulam material of *O. reticulatum* has more than 1,260 chromosomes. It seems that allo- or auto-polyploidy or a combination of the two may have been operative in this genus at some stage in its long history. But the fact that only bivalents are formed at meiosis, whether the somatic number is 256, 512 or 1,262, makes it difficult to decide this question. There is the possibility that these are very ancient polyploids, which in the course of thousands or millions of years might have through the accumulation of genic changes become functionally diploids. And any disadvantage arising from such a multiplication of chromosomes may have been counterbalanced by the parallel attainment of a vegetative mode of reproduction through root buds. Again, it is not improbable that our currently accepted ideas regarding multivalent formation and secondary associations, based largely on observations on favourable angiosperms with small number of medium- or large-sized chromosomes do not hold good in every respect as far as plants with such large numbers and consequently small-sized chromosomes are concerned. A re-examination of these concepts may be necessary in the light of observations on these ancient plants.

It is of interest to enquire whether there is any relationship between chromosome numbers and geographical distribution. If we accept the idea that generally higher numbers are derived from smaller numbers in the course of evolution, it follows that within the same species material from the older strata of the earth's crust, which have longest escaped great geological upheavals would show higher chromosome numbers compared with materials of the same from relatively more recent formations. This relationship may possibly hold good for closely related species as well. The peninsular part of India, comprising the whole of South India, constitutes one of the oldest of such land masses, and it may be expected that in species indigenous to this region higher levels of polyploidy may be seen within any group of closely related species as compared with materials of the same from later formations. An extensive and careful investigation of the tropical Pteridophytes may provide some answer to this and related problems of evolution.

To Professor Irene Manton we are indebted for valuable suggestions and encouragement. Our thanks are due to the Ministry of Education, Government of India, for a generous grant for purchase of research equipment.

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NUCLEAR SHELL NUMBERS IN LIGHT ELEMENTS

THE nuclear scattering of 340 Mev. protons by various elements has been observed by Richardson, Ball, Leith and Moyer.[1] These experimental observations have been theoretically correlated on the basis of the optical model of the nucleus proposed by Fernbach, Serber and Taylor.[2] Using the radial distribution method Gatha, Shah and Patel[3] have obtained a characteristic nuclear density distribution for light elements given by

$$\rho(\bar{r}) = \sum_{q=1}^{3} a_q \exp(-\beta_q \bar{r}^2) \qquad (1)$$

where

$a_1 = 0{\cdot}25 \times 10^{39}$ cm.$^{-3}$, $\beta_1 = 28{\cdot}94 \times 10^{26}$ cm.$^{-2}$,
$a_2 = 0{\cdot}19 \times 10^{39}$ cm.$^{-3}$, $\beta_2 = 3{\cdot}83 \times 10^{26}$ cm.$^{-2}$,
$a_3 = 0{\cdot}10 \times 10^{39}$ cm.$^{-3}$, $\beta_3 = 0{\cdot}75 \times 10^{26}$ cm.$^{-2}$,

and

$$\bar{r} = r \times A^{-1/3}.$$

We have tested the validity of the nuclear density distribution proposed by us from the point of view of nuclear shell numbers for light elements. On the basis of the Thomas-Fermi nuclear model, a correlation has been established by Born and Yang[4] as well as by Yang[5] between the nuclear density distribution

and nuclear shell numbers. It can be written as

$$N_l = (l+3/2)^3/3\pi^2\bar{r}_m^3\,\rho\,(\bar{r}_m) \qquad (2)$$

where N_l = the number of neutrons or protons in the completed shell characterised by the angular momentum l,

$\bar{r}_m$ = the value of $\bar{r}$ where $\bar{r}^3\,\rho\,(\bar{r})$ is a maximum,

$\rho\,(\bar{r}_m)$ = the nuclear density at $\bar{r}_m$.

For the nuclear density distribution obtained by us $\bar{r}_m \simeq 1{\cdot}4 \times 10^{-13}$ cm. while $\rho\,(\bar{r}_m) \simeq 0{\cdot}023 \times 10^{39}$ cm.$^{-3}$. The nuclear shell numbers given by our density distribution are 1·8, 8·4 and 23·1 for $l = 1, 2, 3$ respectively which may be compared with empirically obtained values of 2, 8 and 20. Thus the nuclear density distribution is approximately consistent with this requirement.

M. G. Science Institute, Navarangpura, Ahmedabad-9, *April* 27, 1954.

G. Z. Shah.
K. M. Gatha.

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UNIT CELL AND SPACE-GROUP OF MORELLIN

In a previous note,[1] one of the authors published a preliminary report on the unit cell dimensions and space-group of Morellin, an antibiotic from *Garcinia morella*.[2] Detailed considerations however threw some doubt regarding the space-group, in which the crystal was placed and it was taken up for re-examination and closer study. Good single crystals were kindly lent by Dr. P. L. N. Rao and his co-workers, of the Biochemistry Department.

Oscillation and Weissenberg photographs of very long exposures of the zero and higher layers have confirmed the previous measurements and observations in general. The crystal belongs to the tetragonal system, with the following unit-cell dimensions, $a = b = 15{\cdot}89$, $c = 11{\cdot}6$ Å. Looking for the systematic extinctions, it is found that only in reflexions of the type $(00l)$, the observed ones are those for which $l = 4n$, and hence it suggested, that the c-axis is 4_1 and not 4_2. The previous space-group in which it was placed, *viz.*, $P4_2/m$ has an eight-fold general position and since there are only four molecules per unit cell, all the atoms have to be in very special positions, *viz.*, in two layers with parameters $x, y, 0$; $\bar{y}, \bar{x}, 0$; $\bar{y}, x, \frac{1}{2}$; $y, \bar{x}, \frac{1}{2}$. For a very complex molecule of the type of Morellin which shows pronounced optical activity in solution, it is a highly inconceivable arrangement, a conclusion further augmented by the fact that there is no cleavage plane perpendicular to c, and that the reflections of the type $00l$, $l = 8n$ have not been observed at all. This leaves no doubt about the nature of the screw axis. Finally the crystal exhibits pronounced optical activity under the polarising microscope, which eliminates all the centro-symmetric space-groups. These observations conclusively prove that the space-group is $P4_1 - C_4^2$. Detailed analysis is under progress.

Our grateful thanks are due to Prof. R. S. Krishnan for his kind interest in the work.

Physics Dept., Indian Inst. of Sci., Bangalore-3, *June* 10, 1954.

R. V. G. Sundara Rao.
V. M. Padmanabhan.
Gopinath Kartha.*

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AMPEROMETRIC DETERMINATION OF FERRICYANIDE WITH SILVER NITRATE

The volumetric method for the estimation of the ferricyanide[1] does not give satisfactory results at low concentrations. This investigation was undertaken with a view to estimating small amounts of ferricyanide by amperometric titration with silver nitrate. The manual polarographic arrangement[2] for the titrations using dropping mercury electrode as cathode was employed. In view of the reaction between potassium ferricyanide and mercury,[3] instead of the usual stationary mercury pool, an external saturated calomel electrode was used as a reference anode. Purified nitrogen was bubbled through the solutions to remove the dissolved oxygen. Gelatin was added for suppressing the current maximum. The supporting electrolyte was 0·1 M solution of potassium nitrate. The ferricyanide solutions were taken in the titration cell and the silver nitrate solution was added stepwise from a micro burette. The titrations were carried out at a potential

of $-0{\cdot}3$ volt *vs.* S.C.E., where the diffusion current due to the reduction of the $Fe(CN)_6^{---}$ as well as Ag^+ ions have a limiting value. After each addition of silver nitrate, the solution was well agitated by bubbling nitrogen through it and the precipitate was allowed to settle clear of the capillary tip before measuring the current.

A typical curve for the titration of 50 ml. of $2{\cdot}811 \times 10^{-3}$ M potassium ferricyanide with 0·2497 M silver nitrate gave two intersecting straight lines for various volumes of silver nitrate added. Titrations of 1·6 to 5 millimolar ferricyanide solutions have been carried out. In each case, the composition of the precipitate at the equivalence point corresponded to $Ag_3Fe(CN)_6$. This confirms the previous findings by conductometric[4] and thermometric[5] methods regarding the composition of the precipitate obtained in the $AgNO_3$-$K_3Fe(CN)_6$ titration.

TABLE I

Amperometric titration of potassium ferricyanide with silver nitrate

Volume of ferricyanide solution = 50 ml.; E.M.F. applied = $-0{\cdot}3$ volt. *vs.* S.C.E.; Temperature = $30 \pm {\cdot}05°$ C.

Strength of $AgNO_3$ soln.	Strength of $K_3Fe(CN)_6$ soln. in 10^{-3} M	Calculated titre value in ml.	Observed titre value* in ml.
0·50 M	5·022	1·51	1·52
do	4·016	1·21	1·20
do	3·213	0·97	0·98
do	3·012	0·91	0·91
0·25 M	2·811	1·69	1·68
do	2·409	1·45	1·46
do	1·848	1·09	1·08
do	1·606	0·97	0·96

* Mean of three readings.

It would appear from the table that in most cases the results are within 1 per cent. of the calculated titres. The individual titres were within $\pm 0{\cdot}01$ ml. of the mean values. The titration can thus be used for estimation of dilute solutions of ferricyanide with silver nitrate.

Our thanks are due to Prof. R. P. Mitra for suggestions and interest in the work.

University of Delhi, BALDEV KHOSLA.
Delhi, *May* 18, 1954. HARISH C. GAUR.

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ON THE PYROPHYLLITE DEPOSITS OF TIKAMGARH

THE pyrophyllite deposits of Bundelkhand were for the first time studied in detail by R. C. Misra.[1] He has shown that the so-called Steatite deposits of Hamirpur, U.P., are deposits of pyrophyllite.

The pyrophyllite deposits (78° 55', 24° 51') described here lie between the villages Mawai and Kari in Tikamgarh District (Vindhya Pradesh). The country rock is Bundelkhand granite and the pyrophyllite deposits are found in a large quartz vein 1207' above the sea level. There is no trace of any basic rock near this deposit.

The usual rock is a pink granite which becomes gneissose near the quartz vein. This gneissose granite shows an augen structure. Pyrophyllite occurs in the quartz reef in the form of lenticular masses parallel to its strike. The most evident and easily observed feature is the prominent schistosity of the pyrophyllite rock. The strike of this rock varies from N-S to NNE-SSW. In the field, the rock looks like a variegated slate and breaks into splinters. The different pyrophyllite bodies grade in both directions along the strike into the quartz-pyrophyllite rock and quartz rock. The typical quartz-pyrophyllite rock has a schistose appearance with alternate bands of quartz and pyrophyllite.

Pyrophyllite varies in colour from nearly black to green and to pinkish red. It has a greasy feel and its hardness is about 2. The minerals observed in thin sections associated with the deposits are pyrophyllite, quartz, feldspars, rutile, apatite, zircon, limonite and hæmatite.

Pyrophyllite occurs in the form of scales and is often tabular in habit. The individual scales grow much bigger near the contact of quartz grains. The quartz shows wavy extinction and occurs in the form of thin veins with corroded margins. Orthoclase and microcline are the common feldspars which are much altered giving rise to pyrophyllite and sericite along their margins and cleavages. The margin of the feldspar is usually much corroded. Feldspars are not found in a pure pyrophyllite rock. Rutile and zircon are the common accessories. Rutile occurs in the form of prismatic reddish brown crystals with very high refractive index and showing adamantine lustre in reflected light.

Under the microscope the pyrophyllite is seen to be the last mineral formed. It has

originated at the expense of the feldspars. In a pure pyrophyllite rock there is practically no trace of feldspar, but quartz is always present and shows corroded outline. Quartz grains are often cracked and along these cracks pyrophyllite is formed replacing the former.

Both the field and the petrographic evidences in the present case show that the pyrophyllite has originated through the process of metasomatic replacement of quartz veins by hydrothermal solutions. The same mode of origin has been suggested by R. C. Misra for the deposits he has examined.[1]

Dept. of Geology, B. B. S. SINGHAL.
Banaras Hindu University,
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COMBUSTION STABILIZATION IN LOW VELOCITY GAS-STREAMS

THE object of this investigation was to stabilize the combustion over a wide range of air/fuel ratios, and to reduce the reaction length in a small combustion chamber, designed to operate at high temperatures at atmospheric pressure. For this purpose experiments were carried out with a cylindrical baffle in a combustion chamber.

As a stream of burning and unburnt gases passes over a baffle, certain phenomena occur very rapidly in the wake region. The flow separates over the baffle and a series of eddies is formed in the immediate downstream region. A rapid heat-transfer from the flame to the colder unburnt gases takes place and the latter are raised to the ignition temperature and begin to burn. At the same time, there will be a recirculation of the hot gases in the eddy region, thus furnishing a continuous source of ignition for the unburnt gases. The re-circulation in the wake of the baffle gives rise to vortices which stabilize the flame.[2] This can be explained on reference to Fig. 1. At *a*, there will be mixing of unburnt gases with the flame, because the burning gas is retarded at the baffle surface due to friction, and the unburnt gas forming the outer boundary travels into the slowly moving flame region at *a*. At *b*, the burning continues, and some of the burnt gas which cannot cope with the pressure barrier there, falls into the vortex and is fed back at *c*, thus furnishing a continuous supply of hot gas for the combustion of unburnt gases. The flame length is cut down, because all the burning takes place at *b*, and combustion is smooth and continuous.

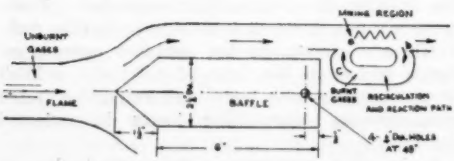

FIG. 1. Flame Stabilization by Re-circulation.

The experiments were carried out in a combustion chamber designed to operate at high temperatures at atmospheric pressure. The set-up consisted of a blower delivering 10 lb. of air per minute to the combustor and a gear pump driven by a variable speed DC motor which supplied the fuel (kerosene oil) at a pressure of 150 psi. The length of the combustor was 18". The stabilizing baffle was mounted centrally in a pipe 12" long which was fitted to the combustor exit. The total length of the combustor and stabilizer unit was 30".

The design of the stabilizer is based on the work of Longwell *et al.*[1] who investigated the phenomena of flame stabilization in high velocity gas streams by baffles. The baffle for the present tests was made of stainless steel. It is 6" long and 2½" diam. with the conical end facing upstream. At the downstream end four inclined holes are drilled to produce better mixing in the region *a*. A traversing pitot tube was fitted to the combustor exit for measuring the velocity head.

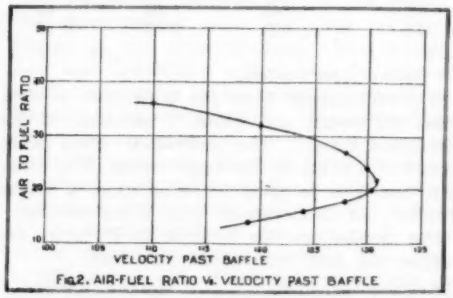

FIG. 2. AIR-FUEL RATIO Vs. VELOCITY PAST BAFFLE

The combustor was operated at different fuel-air ratios starting from a minimum of 40 : 1. The velocity past the baffle was measured for different fuel-air ratios. The upper limit of fuel-air ratio was 14 : 1 when blow out occurred. The performance of the baffle can be seen in Fig. 2 where the velocity past the baffle (in

ft./sec.) is plotted against the air-fuel ratios. It is seen that the velocity gradually increases with richer mixture ratios and is a maximum at about 22 : 1. The velocity again decreases and reaches a minimum at 14 : 1 when blow out occurs.

The baffle stabilizer improved the performance of the combustor. Before the introduction of the baffle the lower and upper air-fuel ratio limits were 1 : 30 and 1 : 18. With the stabilizer, the combustor could be smoothly operated between the air-fuel ratio limits of 1 : 14 and 1 : 36. Further, the flame length beyond the combustor exit was cut down from 3 ft. to a few inches beyond the baffles.

Mech. Engg. Section, G. SRIKANTIAH.
Dept. of Power Engg., A. RAMACHANDRAN.
Indian Institute of Science,
Bangalore-3, *April* 7, 1954.

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THE ADDITION OF BROMINE TO α-β UNSATURATED ACIDS IN CARBON TETRACHLORIDE SOLUTIONS

KINETIC investigations of this reaction in glacial acetic acid have been reported from time to time.[1] These observations suggest that it is worthwhile studying solvent influences since relative rates appeared to be different from the results of competitive reactions.[2,3] It was anticipated that the reaction would be heterogeneous in view of the work of D. M. Williams and of Gwyn Williams.[4,5] To avoid the complication of peroxide effect, these unsaturated acids were chosen for study.

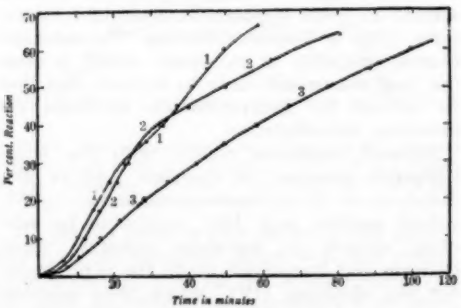

FIG. 1

1.—Pyrex; 2.—Silica; 3.—Alumina; Reactants M/15 at 30·1° C
ββ dimethyl acrylic acid + Bromine

Typical observations are shown in the accompanying figures (1 and 2). Fuller details

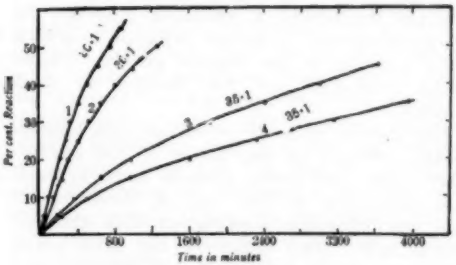

FIG. 2

Transcrotonic Acid + Bromine
1.—Pyrex (temp. 30·1°); 2.—Silica (temp. 30·1°); 3.—Pyrex (temp. 35·1°); 4.—Silica (temp. 35·1°).

are presented elsewhere. The reagents were carefully purified as with the work in acetic acid and the reactions were carried out in complete darkness. The vessels and the added beads of silica or pyrex glass were treated in an identical manner so that the conditions were quite reproducible within the limits of experimental error.

The reactions are definitely heterogeneous, the rate depending on the degree of packing, temperature, nature of surface, concentration and structure of the reactants. The time for a given fraction of the reaction to take place is a convenient criterion for purpose of comparison and the results for such a comparison are given in Table I.

	Concentration of acid	Concentration of Bromine	Time for 10% reaction at 35·1° C.		
			Pyrex	Silica	None
A	0·1 M	0·1 M	370 min.	465 min.	800 min.
	0·05 M	0·05 M	450 min.	750 min.	1590 min.
B	0·05 M	0·05 M	13	10·2	29·5
	0·025 M	0·025 M	78	77	750

A. With crotonic acid; B. with 2 : 2 dimethyl acrylic acid.

The complex nature of a heterogeneous reaction makes the determination of rate constants or of reaction order of doubtful utility for absolute evaluations but are nonetheless useful in a comparative study. Using comparisons

of initial rates and the time for half reactions, some broad generalisations are, however, possible. These values lead to an order of reaction which is initially about four gradually fading off to three and then possibly to two. It is clear that the reaction taking place is between the adsorbed molecules of reactants polarised by the polar surface. A serious objection to a high order reaction is the definite positive temperature coefficient for the reaction in some olefines.

The specific influence of surface also appears to be governed by the nature of the olefine; while silica and pyrex surfaces show appreciable differences in the case of trans-crotonic acid, the difference is negligible with dimethyl acrylic acid. This difference can arise partly from the steric course of the reaction and partly by the superposition of a homogeneous phase in the reaction which might be initiated at the surface. Further work is in progress to examine this aspect of the problem.

The reaction is more sensitive to changes in bromine concentration than to that of the olefine. Starting with M/5 solutions of both reactants while halving the olefine concentration increases the time for 10 per cent. reaction by 50 per cent., halving the bromine concentration causes an increase in the time by over 150 per cent. Fuller details and a consideration of the mechanism will be published elsewhere.

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Madras Christian College,
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THE PREPARATION OF PHENOLIC KETONES AND CHALKONES BY MEANS OF BORON TRIFLUORIDE

IN carrying out the first synthesis of 5 : 6 : 7-trihydroxyisoflavone and its 5 : 7-dimethyl ether it was shown that 2 : 5-dihydroxy-4 : 6-dimethoxyphenyl benzyl ketone can be prepared by the condensation of 2 : 6-dimethoxyhydroquinone (I) with the boron trifluoride complex of phenylacetic acid.[1] The phenol (I) was shown by Chapman, Perkin and Robinson to be unreactive in the Hoesch and Friedel-Crafts reactions.[2] The use of acid-boron trifluoride complexes is a convenient general method for the preparation of phenolic ketones and chalkones by the Nencki reaction. Thus, when the phenol (I) or antiarol is dissolved in the commercially available boron trifluoride-acetic acid complex (BF_3, CH_3COOH) and poured into ice after leaving overnight at room temperature, the corresponding acetophenones are obtained in 60-70 per cent. yield; Mauthner[3] prepared 2 : 5-dihydroxy-4 : 6-dimethoxyacetophenone by the Fries migration of the diacetate of (I) and Sastri and Seshadri[4] by the persulphate oxidation of phloracetophenone dimethyl ether. 2-Hydroxy-4 : 5 : 6-trimethoxyacetophenone has been prepared very recently by Krishnamurti and Seshadri[5] in a yield of about 30 per cent. by the Friedel-Crafts reaction between antiarol and acetyl chloride.

Resorcinol and pyrogallol react with boron trifluoride-acetic acid complex at room temperature, giving resacetophenone and gallacetophenone in 80-90 per cent. yield; with β-naphthol a boron-trifluoride complex (m.p. 184°) of the ketone is first obtained and boiling with water for a few minutes gives 1-acetyl-2-naphthol in 93 per cent. yield.

When cinnamic acid (2 mol.) in chloroform is saturated with boron trifluoride, resorcinol is added, and the solution is left overnight at room temperature, 2 : 4-dihydroxychalkone (II) is obtained in 70 per cent. yield.[6] Pyrogallol under similar conditions gives an 80 per cent. yield of the corresponding chalkone.[7]

Treatment of the chalkone (II) with tosyl chloride (1 mol.) in aqueous sodium carbonate yields the monotosylate, which can be cyclized readily to 7-tosyloxyflavone (III) by means of selenium dioxide.[8] Caustic potash in aqueous acetone at room temperature overnight hydrolyses (III) to 7-hydroxyflavone. The selenium dioxide oxidation of chalkones, which is often the most convenient route to flavones, can thus be utilized for hydroxyflavone syntheses not involving demethylation.

Antiarol condenses readily with the boron trifluoride complex of cinnamic acid to give 2-hydroxy-4 : 5 : 6-trimethoxychalkone (IV), yellow needles, m.p. 100°, oxidizable by selenium dioxide to baicalein trimethyl ether. Oliverio and Bargellini[9] quote the m.p. 103-04° for the chalkone (IV), which they prepared by the usual benzaldehyde condensation; Rajagopalan and Seshadri[10] obtained a bright yellow liquid, which could not be crystallized, but Narasimhachari, Sastri and Seshadri[11] described

it subsequently as yellow broad rectangular plates melting at 132-33°.

Dept. of Chemical Tech., R. MANI.
University of Bombay, K. VENKATARAMAN.
June 8, 1954.

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SOLVENT REFINING OF GROUNDNUT AND MOWRAH OILS BY ETHYL ALCOHOL

IN studying the suitability of ethyl alcohol for deacidification of some vegetable oils by liquid-liquid extraction, the following features have been noticed (Fig. 1).

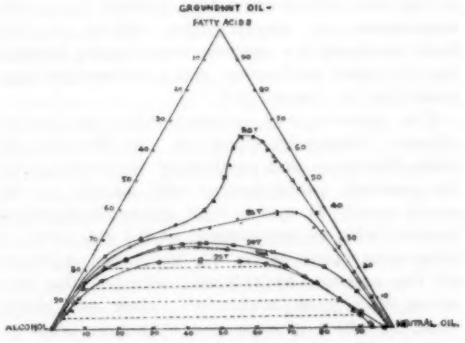

FIG. 1. Mutual solubility curve for the system: Neutral groundnut oil-Fatty acids-Alcohol. Curve 90 A obtained by the 'agitation' method. Curves 95 T, 90 T, 85T and 80 T obtained by the 'turbidity' method.

1. The tie lines (shown dotted in the figure) of the mutual solubility curve, 90 A, are practically horizontal showing that ethyl alcohol (90 per cent. by weight) is non-selective at room temperature (30 ± 2° C.) and at atmospheric pressure, as far as the mixed fatty acids and the mixed glycerides of the two oils are concerned.

2. All the mutual solubility curves were obtained by the 'Turbidity' method.[1] In the case of 90 per cent. ethyl alcohol, the 'Agitation' method was also employed to see if the solubility curves obtained by the two methods agreed. In the latter method, the three weighed components, *viz.*, neutral groundnut oil, groundnut oil fatty acids and ethyl alcohol were shaken in a stoppered separating funnel for 2 hours and the mixture was kept overnight for separation into two layers. The oil layer was completely withdrawn and analysed. Alternatively, portions from the two equilibrium layers were withdrawn and analysed for the three components in each. Thus, the composition of the two phases was known and several pairs of such equilibrium phases were analysed. It was found that the solubility curves by the two methods did not agree (curves 90 A and 90 T) and that the deviation was greater on the oil side. It has been confirmed that the observed deviation is not caused by changes in temperature of measurement to the extent of ± 2° C. Although it is not possible at this stage to give the real explanation for this deviation, the difference in the conditions under which estimations by the two methods are carried out might be one of the reasons.

3. With the use of more dilute alcohol, the region of heterogeneity has naturally increased, but in addition, a hump also has appeared in the mutual solubility curve to its right. A distinct hump is seen with 80 per cent. ethyl alcohol indicating sudden decrease in the solubility of oil and its fatty acids in ethyl alcohol. A similar abnormal behaviour was noticed by Othmer and Serrano[2] in the system, acetic acid —caproic acid—water. They have stated that "chemical association of either caproic or acetic acids or of one or both of the acids and water may be the reason of this abnormality".

Dept. of Chem. Tech., J. S. CAMA.
University of Bombay, M. H. DOMADIA.
Bombay-19, J. G. KANE.
October 26, 1953.

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A SIMPLE PAPER CHROMATOGRAPHIC METHOD FOR THE DETERMINATION OF LACTOSE IN MILK

RECENTLY Honer and Tuckey[1] have described a paper chromatographic method for quantitative estimation of lactose in milk. The lactose was determined by cutting the paper containing

the sugar after separation into a series of segments and estimating the sugar in each segment using the alkaline ferricyanide reagent. The authors state that the procedure as described by them is time-consuming and would therefore not be an appropriate method for lactose determination in a control laboratory.

A simple paper chromatographic procedure is now described by which the lactose content of milk can be determined quantitatively. The method consists in spotting an accurate amount (20 μl) of diluted milk (10 g. of milk diluted to 100 ml.) on the circumference of a circle (4 cm. diam.) drawn at the centre of a circular filter-paper (Whatman No. 1, 18 cm. diam.) and known amounts of standard solution of lactose on either side of the milk spot. After the spots are dried the paper is developed with the solvent mixture of *n*-butanol-acetone-water (20-70-10). After the completion of development the paper is dried and treated with the reagent triphenyl tetrazolium chloride according to the procedure described by Giri and Nigam[2] for the separation and determination of sugars by circular paper chromatographic technique. The red bands of lactose are then cut, the colour extracted with 95 per cent. alcohol and estimated in a Klett Summerson Photoelectric Colorimeter.

The following table gives the percentage of lactose in some of the samples of cow and buffalo milk analysed by the method described above together with the percentage recovery of added lactose to cow milk:

Sample No.	Lactose (per cent.)	Recovery (per cent.)
	Cow Milk	
1	4·3	91
2	4·4	97
3	4·3	93
	Buffalo milk	
4	4·6	..
5	4·8	..
6	4·7	..

The method is accurate to $\pm$ 10 per cent.

Quickness and simplicity of operation combined with accuracy are the unique features of this method which can be recommended for routine analysis of milk samples. Another advantage of the chromatographic method is that it demands less skill and it is more specific than other methods in which sugars other than lactose when present in milk vitiate the results. A number of samples can be analysed rapidly at a time, which is of great significance in routine analysis of milk samples. In practice it is convenient to chromatogram large number of samples at a time and estimate the colour by extraction later, as it is found that the colour remains stable for a long time.

Since lactose is the least variable among the major constituents of milk, the method can be used for detecting the adulteration of milk with water or other sugars in control laboratories where numerous samples come in for quick disposal.

Dept. of Biochem., Indian Inst. of Sci., Bangalore-3 (India), *March* 15, 1954.

A. NAGABHUSHANAM.
K. V. GIRI.

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SUGAR CONSTITUENTS OF THE SAPONIN FROM MAHUA OIL CAKE (*BASSIA LATIFOLIA*)

EXCEPT the work of Van der Haar,[1] no study appears to have been made of the qualitative composition of the sugar mixtures present in the hydrolysis of saponins, obtained from seeds of various *Sapotaceæ*. The present work was undertaken to identify the sugars in the hydrolysate of the saponin from *Bassia latifolia* by the latest method of paper chromatography according to Partridge.[2]

The saponin was isolated from the mahua oilcake (kindly supplied by the Swastik Oil Mills, Bombay) and purified by removing pectin by repeated precipitation with alcohol in the usual way.[3] It was a light brown hygroscopic powder with an ash content of 0·4 per cent. A chromatographic study of the sugar mixtures of the saponin hydrolysate revealed the presence of glucose, arabinose, xylose and rhamnose, in which glucose and rhamnose predominated. The absence of galacturonic acid[3] in the paper chromatography of the hydrolysate showed the saponin to be free from pectin. By using the osazone method, Van der Haar[1] found the presence of glucose, arabinose and rhamnose in the saponins from *Mimusops elengi* and *Archas sapota*, two different species of the *Sapotaceæ* family. The osazone method has its limitations for separation and characterisation of the components of a sugar mixture and is much less versatile compared to paper chromatography. The work of Van der Haar therefore requires re-examination.

In the present study, the qualitative characterisation of the unknown sugars was carried through the parallel spotting of the known pure sugars by the "descending" method and not through the absolute Rf values. The systems, (*a*) *n*-Butanol-acetic acid-water (4 : 1 : 5) for 48 hr. and (*b*) phenol for 24 hr. were made use of, while aniline oxalate was used as the spraying agent.

The presence of free sugar in the "glucoside", as indicated by paper chromatography, was negligible. Further work is in progress and the details will be communicated later.

My sincere thanks are due to Prof. R. C. Shah for his kind interest in the work and to Dr. S. C. Bhattacharyya and Mr. R. S. Davalikar for the help rendered in the course of the work.

National Chem. Lab. of India, N. L. DUTTA.
Poona-8, *May* 19, 1954.

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THE SEPARATION OF AMINO ACIDS BY BUFFERED CIRCULAR PAPER CHROMATOGRAPHY

A METHOD for the separation of the overlapping amino acids by circular paper chromatographic technique has recently been described by Giri and Rao.[1] This involves the complicated procedure of cutting out, eluting and spotting the overlapping amino acids and rechromatographing with suitable solvents. Recently, McFarren[2] has published a new modification of one-dimensional technique for the separation and identification of the different amino acids from a mixture, by employing filter-paper and solvents buffered at selected pH. This method is a distinct improvement over the existing methods as it has made it possible for the first time the separation and identification of the different amino acids by one-dimensional chromatographic technique. In the present investigation the separation of the commonly occurring amino acids by buffered circular paper chromatographic technique has been studied. A preliminary account of the results is reported in this communication.

The apparatus used for the circular paper chromatographic technique was the same as that described by Giri and Rao.[3] The following solvents used by McFarren[2] for the separation of amino acids on filter-paper sheets using unidimensional technique were tried: (1) Phenol saturated with 12·0 pH buffer in conjunction with circular filter-paper (Whatman No. 1) buffered at the same pH, (2) *m*-cresol saturated with 8·4 pH buffer using circular filter-paper buffered at the same pH. The composition of the buffers were the same as that described by McFarren.[2] The chromatograms were developed twice in each case as suggested by Jeanes, Wise and Dimler[4] for the separation of carbohydrates. The chromatograms were irrigated for about 8 hours each time, after which they were dried at 80° C. for 3 minutes. After the second irrigation, the chromatograms were dried at 80° C. for 3 minutes, and uniformly sprayed with an acetone solution containing 0·2 per cent. ninhydrin and 5 per cent. acetic acid and heated at 80° C. for 5 minutes to develop the colour produced by the amino acids.

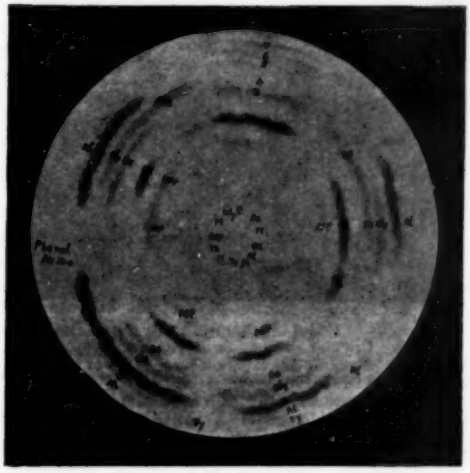

FIG. 1. Circular paper chromatogram showing the separation of amino acids : Solvent ; Phenol saturated with 12·0 pH buffer.
C : Casein hydrolysate ; M : Mixture of known amino acids ; Gl : Glutamic acid ; Se : Serine ; Al : Alanine ; Ty : Tyrosine ; Th : Threonine ; Asp : Aspartic acid ; Gly : Glycine.

The results show that (1) *m*-cresol saturated with buffer of pH 8·4 gives a clear separation of alanine, arginine, tyrosine, histidine, valine, methionine and phenylalanine, and (2) phenol saturated with a buffer of pH 12·0 causes a satisfactory separation of aspartic acid, glutamic acid, serine, glycine, threonine and alanine. Photographs of typical chromatograms showing

the separation of different amino acids are shown in Figs. 1 and 2.

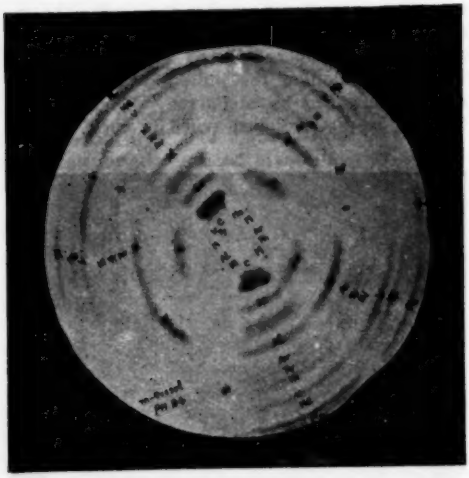

FIG. 2. Circular paper chromatogram showing the separation of amino acids. Solvent : *m*-cresol saturated with 8·4 pH buffer.

C : Casein hydrolysate ; M : Mixture of known amino acids ; Me : Methionine ; V : valine ; Ar : Arginine ; Ph : Phenylalanine ; Hi : Histidine ; Al : Alanine ; Ty : Tyrosine ; Se : Serine.

Our thanks are due to Dr. V. Subrahmanyan, Director of this Institute, for his keen interest in this work.

K. KRISHNAMURTHY.
M. SWAMINATHAN.

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TRYPTOPHANE UTILISATION BY *NEUROSPORA CRASSA* AND THE INFLUENCE OF PURE AMINO ACIDS

ONE of the factors which seemed to affect the conversion of tryptophane to nicotinic acid was the influence of certain proteins, when fed at lower levels with tryptophane-low or nicotinic acid free ration. The adverse effect produced by the proteins was overcome by the addition of tryptophane or nicotinic acid.[1,2] This relationship of the 'level of dietary protein' and 'nicotinic acid requirement' first established in rats was subsequently confirmed in the case of chicks,[3] pig[4] and dog.[5] The adverse effect produced by the proteins was attributed to the various amino acids present in them and in turn to their influence on the digestive tract.[6,7] Later work,[8,9] suggested that the effect of the protein or the amino acids contained therein might result from an inhibition in the conversion of tryptophane to nicotinic acid by affecting certain enzyme systems in it, rather than from an introduction of an increased requirement of nicotinic acid brought about by the micro-organisms. To elucidate this observation further, experiments were carried out to find the influence of various amino acids on the utilisation of tryptophane by *Neurospora crassa*.

A nicotinic acid dependent strain of *Neurospora crassa* (39401) kindly supplied by Dr. H. K. Mitchell, of California Institute of Technology, was used. Strain 39401 is able to utilise all the metabolites of tryptophane for nicotinic acid synthesis and the gene is located at the precursor—indole linkage as illustrated the accompanying scheme :

gene block
↓
precursor ⟶ indole ⟶ tryptophane ⟶ kynurenine 3-hydroxykynurenine ⟶ ⟶ 3-hydroxy anthranilic acid ⟶ nicotinic acid

The organism was cultured in Fries' medium as described by Horowitz and Beadle.[10] The organism was allowed to grow in 50 c.c. conical flasks, the total volume of the media being 10 c.c. containing the following substances in the basal medium in mg., ammonium tartrate: 25; NH_4NO_3 : 10; K_2HPO_4 : 10; $MgSO_4$: 5; NaCl and $CaCl_2$: 0·1 (each); dextrose: 200; and the following trace elements in gamma, B: 10; Mo: 2·0; Fe: 2·0; and Zn: 20 and vitamin biotin 0·5 milli-microgram. The pH of the medium was 5·6. After 72 hours growth at 30° C., the mycelia were carefully removed, washed, dried at 105° C. and the dried mycelia were weighed in a Roller Smith Torsion balance.

The influence of 21 amino acids added singly to the medium was studied. The following amino acids *l*-leucine, *dl*-isoleucine, *l*-hyroxyproline, *dl*-valine, *dl*-threonine, *dl*-β-phenylalanine, *dl*-methionine, *l*-cysteine, glycine, *l*-tyrosine, *dl*-alanine, *dl*-serine, and β-alanine were found to inhibit the utilisation of tryptophane. The inhibition index varied from 4 to 100, the highly inhibitory amino acids being

dl-β-phenylalanine, *l*-leucine, *dl*-methionine, and *l*-cysteine. However, with *l*-tyrosine, *dl*-alanine and *dl*-valine an increase in growth over that of the control, when the amino acids were present in very low amounts was observed. Eight amino acids *l*-proline, *l*-arginine, *dl*-aspartic acid, *l*-histidine, *l*-glutamic acid, *l*-citrulline, *l*-lysine and *dl*-ornithine had no influence when added even upto a level of 2·5 mg. per c.c. of the medium.

From the above observations, it is suggested that certain amino acids inhibit the various enzyme systems which are taking part in the conversion of tryptophane to nicotinic acid. A study of the influence of the various amino acids on the utilisation of other tryptophane metabolites like formylkynurenine, kynurenine, 3-hydroxykynurenine, 3-hydroxy anthranilic acid and nicotinic acid is in progress and will be published in detail elsewhere.

E. R. B. Shanmuga Sundaram.
P. S. Sarma.

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ON THE BREEDING HABITS OF THE COWRY *ERRONEA ERRONES* (LINNÉ)*

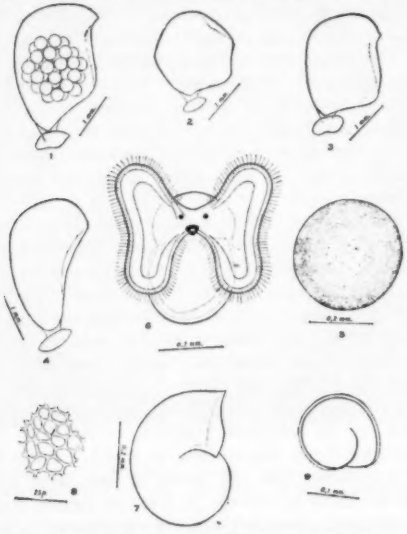
Cowries are fairly common in the shallow areas of Palk Bay and Gulf of Mannar. The species commonly found in the area between Mandapam Camp and Mandapam has been identified as *Erronea errones* (Linné). Satyamurti[1] records it as also occurring in Pamban, Krusadai and Shingle Islands. Schilder and Schilder[2] have differentiated this species into four geographical races. The species around this region seems to belong to the race *bimaculata* distinguished by features of the aperture of the shell which is narrow behind and much dilated in front. Ray[3] gives an account of the systematics, habits and habitats, transformation, use, etc., of cowries. Hornell[4,5] and Gravely[6] do not make any mention of the egg mass of cowries and no information is available on the reproduction of Indian cowries.

Lo Bianco[7] was probably the first to describe the egg mass and brood-protecting habit in the genus Cypræa. Vayssière[8,9] besides describing the egg masses of a few species of cowries, gives a small account of a preserved egg mass of *Cypræa errones* of New Caledonia. The few details given by him differ from the present account.

The cowries were found upon the undersurface of the boulders or stones perching over the egg masses with the foot completely extended and covering the egg masses. The animal is quite restless when disturbed while brooding the egg mass. In one instance it was observed that when the adult specimen was completely removed from the egg mass and kept at about 4" away from it, it crept slowly back to its original position. Breeding was observed from September to April. According to Vayssière, the egg mass of the New Caledonian form is oblong, 11 mm. in length, 8 mm. in breadth and 2-5 mm. in thickness. It is found, however, that in the case of the Indian form the egg mass is nearly circular about 23-26 mm. across, and 8-10 mm. in height at the centre. It was observed that the capsules of these egg masses are deposited in 5-6 layers superimposed upon one another in the form of a cone, the lowest layer being the widest in diameter. The newly laid egg mass is yellowish in colour. It turns gradually brown and ultimately dull purple with the development of the larvæ. The four egg masses examined contained 481, 501, 507 and 517 capsules respectively. According to Vayssière, the capsule of the New Caledonian form contained 20-25 eggs. The number of eggs varies from 30-70 per capsule in the present species. On an average the number of eggs per egg mass will be about 24,500. All of them are potential embryos without nurse eggs.

The capsules are pouch-like and of different sizes and shapes (Figs. 1-4). Each one is provided with a base. Of the 25 capsules examined from different egg masses the length and breadth vary from 1·85-3·25 mm. and 1·35-1·85 mm. respectively. They are horny, glossy and transparent but of pale yellow colour. The larvæ escape through the distal end of the capsule. The eggs are yellowish brown. Vayssière does not give dimensions of the egg

of the New Caledonian species except that the eggs are 14 times bigger than that of *Cyprœa staphylœa*. The newly laid unsegmented egg of the Indian form measures about 0·363-0·367 mm. across (Fig. 5). The newly-laid egg masses



FIGS. (1–4). The egg capsules of different sizes and shapes. FIG. 5. The egg. FIG. 6. The newly hatched Veliger. FIG. 7. The larval shell. FIG. 8. The sculpture of the larval shell. FIG. 9. The Operculum.

kept at the laboratory for observation either show abnormal development or no development at all and hence the exact date of development from the egg to the formation of veligers could not be given. Probably the eggs require the brooding care of the adult specimen until a certain stage of development. An attempt has been made to keep the adult brood-caring specimens at the laboratory in large glass troughs. The animal leaves the egg mass in a day or two at the most. But in the natural habitat the animal continues the brooding till veligers are about to hatch out from the capsules. However, in the egg mass of fairly advanced stages kept at the laboratory the further development was normal and the veligers are formed. Such an egg mass kept at the laboratory on 3rd September 1952 liberated the veligers after 11 days.

The newly hatched veligers measure 0·435-0·473 mm. across the shell (Figs. 6 and 7). The latter is pale brownish in colour with reticulate markings upon it (Fig. 8). The reticulation is only visible under high power and more or less like that of the larval shell of *Simnia patula* described by Lebour.[10] The extreme tip of the outer lip of the shell is pointed and provides support to the velum. The velum is bilobed and colourless with long cilia bordering the margin. There is a distinct sub-velum with short cilia which lead the food currents towards the mouth. The eyes are distinct but only the right tentacle is present and the left one is not yet developed. The statocysts are not clear in the swimming posture of the larvæ. The foot is very well developed, bears cilia all over it and shows diffuse, black colouration. The operculum (Fig. 9) is colourless and distinct. While swimming the larval shell is either partly or fully surrounded by the mantle. The mouth, œsophagus, stomach and intestine are dark purplish in colour and are distinctly seen through the shell. The heart beat is clearly visible. The liver is yellowish and appears pressed against the stomach.

The larva has been kept alive at the laboratory for about 5 days. No visible changes were noticed during the time and it is probable that the larval period is of long duration. The larva at this stage of development is quite common in plankton collections from Palk Bay between September and April.

I am indebted to Dr. N. Kesava Panikkar for his guidance and encouragement.

Central Marine Fisheries Res. Station, Mandapam Camp, *March* 30, 1954. A. V. NATARAJAN.

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp.

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MATING REACTIONS IN THE COMMON INDIAN HOUSEFLY, *MUSCA DOMESTICA* NEBULO (FABRICIUS)

THE male and the female of the common Indian housefly, *Musca domestica* nebulo (F.) are easily distinguished from each other by external characters, and are therefore suitable for a study of their mating behaviour.

Male and female flies of the same age were selected in a particular ratio (30 males to 6 females). The cage containing them was kept under observation in different months, continuously for 12 hours of the day, beginning from 6·30 a.m. onwards. The number of mating reactions per half hour was plotted over the whole observation period. Temperature, relative humidity, and light intensity were recorded in each case.

Figs. 1 and 2 show clearly that houseflies of this species show a distinct *diurnal mating*

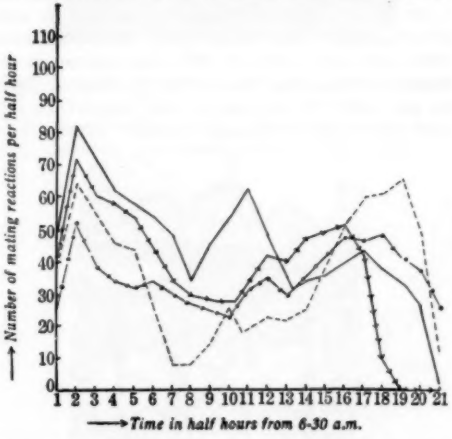

FIG. 1. Diurnal Mating Rhythm in the months of June, July, August and September: Broken line–June, Straight line–July, Line with circles–August, Line with arrows–September.

rhythm. Two peaks of mating activity were observed, one in the morning and the second in the afternoon, the exact time of each peak differing slightly for the different months. While a diurnal rhythm has been described for the activities of several other arthropods[1–3], as far as we know, no diurnal mating rhythm has been recorded in houseflies by any previous worker.

The effect of light on this mating rhythm was specially studied, by subjecting the flies to "reversed illumination", *i.e.*, keeping them in darkness during the day and under artificial illumination during the night. Under these conditions all activities of the flies ceased during the day. The intensity of illumination produced in two different cages, in which the mating reactions of the flies were studied simultaneously, was made 200 foot-candles for the first, and 75 foot-candles for the second cage, by keeping them at different distances from several (fluorescent) light sources in a dark room

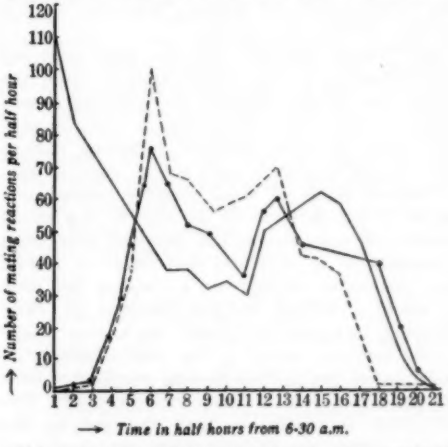

FIG. 2. Diurnal Mating Rhythm in the months of October, November and December: Straight line—October, Broken line—November, Line with circle—December.

throughout the night. The mating reactions thus observed, were recorded in two different curves in which the number of reactions was plotted against the time of observation. It is quite evident from these two curves (Fig. 3) that (*a*) at 75 foot-candles a reversal of the

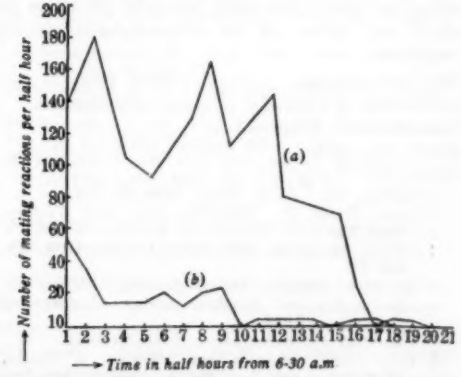

FIG. 3. Effect of the Intensity of Light on the Mating Rhythm: Cage (*a*) exposed to 75 ft. candles, Cage (*b*) exposed to 200 ft. candles during the night.

normal rhythm was observed, in so far as the usual mating rhythm with its two characteristic peaks, now appeared during the night; and that (*b*) in the stronger illumination, mating reactions were inhibited to such an extent that the usual rhythm was suppressed. Thus, darkness, as well as very strong illumination, will upset the normal mating rhythm of the housefly. Work on the effect of other factors like temperature and relative humidity on this rhythm is now in progress.

The mating reaction has also been analysed with reference to the stimuli emitted from the female which are essential for eliciting a response in the male. Contrary to the assumption made by most authors, olfactory stimuli were found to play a very minor part, if any. A dummy made of wool, roughly corresponding to a female housefly as regards the visual stimuli of size, shape and relative brightness (luminance) is sufficient not only to attract any amount of males from a distance but even to elicit a typical mating response at close quarters, including the "jump" on to the "back" of the dummy, which is the most characteristic phase of the normal mating reaction in both *M. domestica* and *M. domestica* nebulo.[4,5] This behaviour is similar to that observed by the senior author in M. *domestica* on dummies.[6] "Queen cages" of wood with wire-netting covers, containing female flies, which were thus made invisible to the males but could be smelt, failed, on the other hand, to attract the males to any greater extent than did similar cages containing male flies, or no flies at all. This result suggests that, under the condition of the experiment, the olfactory stimuli emitted by female houseflies were not sufficient in themselves to attract the male housefly, let alone to elicit any phase of its characteristic mating response.

Dept. of Zoology, University of Poona, Ganeshkhind, Poona-7, *March* 15, 1954.

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L. MULHERKAR.

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REPORT ON *BIDDULPHIA TUOMEYI* (BAIL) ROPER—A DIATOM NEW TO INDIA

So far, eight species of *Biddulphia* have been recorded from India, from the Madras and the Travancore coasts, *viz.*, *B. pulchella* Gray, *B. sinensis* Grev., *B. mobiliensis* Bailey, *B. heteroceros* Grun., *B. rhombus* (Ehr.) W. Sm., *B. longicruris* Grev., *B. regia* Schulze, and *B. granulata* Roper.[11, 12, 14] In my collection of diatoms from the Chilka Lake (lat., 19° 28′ and 19° 54′ N.; long., 85° 6′ and 85° 35′ E.), I came across a species of *Biddulphia* which does not appear to have been reported earlier from India. Opportunity is, therefore, taken in this communication, to record this species from this region.

The following is a short description of the Chilka diatom: Frustule in girdle face with deep constrictions, dividing the valve face into three median mammiloid elevations or lobes; lobes beset with short spines, the middle lobe being considerably larger than the two lateral ones and with one or two long spines at its summit, measuring about 11·2 μ in length. Valve at the poles of the apical axis drawn out into well developed processes. Process inflated both

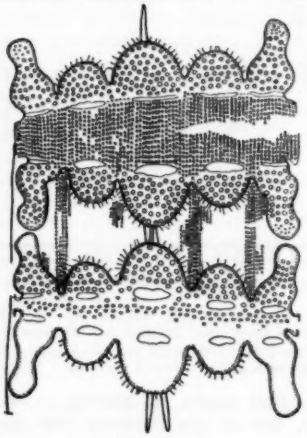

FIG. 1

FIG. 1. *Biddulphia tuomeyi* (Bail.) Roper, girdle view, × 430.

at base and apex and somewhat reflexed, extending farther than the mammiloid elevations, and twice the length of the adjacent and about 1/3 longer than the central lobe. Cell-wall areolate, areolation circular, larger and in radial or concentric lines on the lobes, finer and in parallel rows on the connecting membrane

and girdle. The areolæ at the tips of processes much finer than those at their bases. Apical axis, 105·6 μ; pervalvar axis 54·4 μ and at the poles 57·6-60·8 μ. Areolæ in valves, 4-5 in 10 μ, and in the connecting membrane, and girdle, 7-9 in 10 μ (Figs. 1 and 2).

FIG. 2

FIG. 2. Photomicrograph of *Biddulphia tuomeyi* (Bail.) Roper, × 380.

Habitat.—Chilka Lake—planktonic, in the outer channel. Extremely rare. April 1950.

FIG. 3. Map showing the world distribution of *Biddulphia tuomeyi* (Bail.) Roper (shaded portion).

The present diatom agrees well with the species *Biddulphia tuomeyi* (Bail.) Roper, in its general characters (*cf.* also Figs. of Bailey,[2] Pl. III, Figs. 3 and 4; Castracane,[4] Pl. XXVI, Fig. 10; Hustedt,[10] Fig. 491; Roper,[13] Tab. 1, Figs. 1 and 2; van Heurck,[16] Pl. XXXIV, Fig. 895; Williamson,[17] Fig. 1).

Apparently widely distributed in the warmer seas, in the American waters (common along the S. Atlantic coast of N. America, St. Augustine, Bermuda, Virgin Isls., and Natal in S. America), in the Mediterranean (west coast of Italy, Naples, Corsica, North Adriatic), and in a few stations in and about Indonesia (Sumatra, Bali-sound, Banda sea and Dutch New Guinea, and possibly also extending into the Pacific), and also occurring as fossil in the Miocene deposits of California, in the siliceous infusorial marls of Piscataway (Maryland) and Petersburg (Virginia) and New Jersey in N. America, in Levant Mud, and in Hungary in Europe (Fig. 3), the extension of records of this species to the Indian region, from where it has not been known earlier, is of considerable interest. Further, the previous records indicate for the species a pelagic habitat or a fossil state. The present diatom was, however, collected from an estuarine area at the outer channel of the Chilka Lake, a few miles distant from the mouth of the lake proper.

Curator, Industrial Section, K. S. SRINIVASAN.
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PIRICULARIA SPECIES ON *SETARIA INTERMEDIA*, ROEM AND SCHULT

Piricularia oryzæ has been reported as infecting *Oryza sativa*, *Oryza cubensis* Kawamura,[1] a number of cultivated cereals and also certain wild grasses. Among the cultivated cereals, the suscepts so far reported are: *Eleusine coracana*, *Setaria italica*, *Triticum vulgare*, *Hordeum vulgare* and

Secale cereale Padwick.[2] It has also been reported on the following wild grasses: *Panicum miliaceum* Simonds,[3] *Panicum repens* Thomas,[4] *Panicum ramosum* Butler and Bisby,[5] *Digitaria marginata* Ramkrishnan,[6] and *Dactylotenium ægyptiacum* Thomas.[4]

The authors in 1953 Abi* at Kalvakurthi village in Mahboobnagar District found *Setaria intermedia* to be freely growing on the bunds of a rice seed farm wherein HR.35 was transplanted. The lamina of *Setaria intermedia* showed lesions closely resembling blast. The specimens were, therefore, brought to the laboratory at Himayetsagar and carefully examined.

The lesions on the lamina of *Setaria intermedia* were 3·8 mm. long and 1·9 mm. wide. They had a dull greyish appearance in the centre and the outer rim was dark brown. In the case of severely infected plants, the centre of the lesions was almost straw-coloured. Scrapings from the lesions were examined. Conidia that were biseptate, piriform, with round base and narrowed apex almost hyaline to pale olive were found. They measured 21·96-29·28 × 8·88-10·98 μ. The corresponding measurements of spores of *Piricularia oryzæ* are 14-40 × 6-13 μ. *Setaria intermedia* may, therefore, probably be a host of *Piricularia oryzæ* subject to cross-inoculation test.

It may be mentioned that stray plants of HR.35 from the seed farm bore similar lesions though the incidence was comparatively less. On examination, blast spores were detected from the lesions also. *A priori*, it is difficult to say whether the paddy infected the wild grass or *vice versa*. Cross-inoculation studies are being made.

The authors wish to acknowledge the help rendered by the Plant Pathologist, Himayetsagar, Hyderabad.

Agril. Expt. Station, Himayetsagar, Hyderabad, *April* 12, 1954.

M. S. PAWAR.
S. A. KULKARNI.

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MASS ASSEMBLAGE OF THE COCCINELLID BEETLE, *EPILACHNA BISQUADRIPUNCTATA* (GYLLENHAL) IN CHOTA NAGPUR

ALTHOUGH several interesting cases of mass assemblage of ladybird beetles are known from America, Europe, Russia and Africa, only two such cases have hitherto been recorded from the Indian region, namely, that of the fungivorous species, *Thea bisoctonotata* Mulsant, which was observed by the author[1] in a great congregation on a tree in Model Town, Lahore, in the winter of 1936, and of *Coccinella septempunctata* Linn. very recently observed by Mani[2] on the glacier beds at the Lakka pass (15,000′) in Dholpur Range in the Western Himalayas.

During February 1954, while on a collecting tour with the Zoological Survey of India party in Chota Nagpur, Bihar, the author came across several congregations of a small (4-5 mm. long) herbivorous coccinellid, *Epilachna bisquadripunctata* (Gyllenhal), at Chatra (*ca.* 1,400′) District, Hazaribagh. The congregations were observed in the vicinity of a small stream called Hiru which passed through a thinly wooded area, about 1½ miles south of Chatra dak bungalow. The stream was mostly dry at the time of the visit but here and there a number of small pools, connected by slow-moving water, were present. Along the banks and on the rocks which formed small islands, there was a fairly dense growth of nearly 2′ tall grass (*Eleusine* sp.). It was near the base of the grass and on the ground between the plants that the beetles had congregated. These could not be spotted from a distance but were easily located when the grass was parted with hands. Within an area of about a thousand square yards, four different congregations were observed. The smallest congregation was spread over a piece of ground about 9″ long and 6″ wide. From the sample count in the field it appeared that this lot alone must have contained some three to four thousand beetles. The largest assemblage observed in the area covered a ground which was nearly 4′ long and 2½′ wide. The beetles were lying almost closely packed and over one another. In each assemblage the depth of the mass of beetles varied from 2″-4″ as judged by thrusting a pencil through it. Obviously the beetles were in a resting state as they did not move when disturbed. Most Coccinellidæ simulate death when disturbed but become active after a short time. In the present case they remained inactive throughout; even when disturbed persistently or shaken, they moved

only reluctantly and exuded the yellow fluid characteristic of the family. In no case did they take to flight though they had well-developed membranous wings.

The grass as well as other plants in the vicinity were also examined but these did not show any sign of attack by the lady-bird beetles. Generally it is easy to find out whether or not a herbivorous lady-bird beetle has fed on a certain plant because the beetles leave characteristic markings on the host plant. When a handful of them were brought for further observations in the laboratory, they continued to remain in the resting state and did not accept any food including the grass on which they were collected. A large number of them were dissected but their stomachs were found to be almost empty and without any trace of greenish plant tissue or juices. The abdomen of each, irrespective of its sex, was found to be full of stored fatty bodies and suggested that the beetles were not starved but were in a peculiar physiological state. The sexes were equally represented and the females did not show any advanced stage of development of the ovaries.

The significance of the phenomenon of mass assemblage in Coccinellidæ is little understood. Various explanations such as lack of food, the urge to seek more equitable temperature or be attracted by a peculiar smell or the opposite sex (with a view to ensure maximum fertilization) have been suggested. Others have considered it to be purely of physiological origin and not a result of lack of food or similar conditions. The present observations seem to support the latter view but further records and detailed observations would no doubt be necessary for a fuller explanation of the phenomenon as occurring in India. Such records would also be useful from the economic point of view. In the case of herbivorous species, some of which are notorious pests, the assembled beetles may be easily collected and destroyed as is done in Persia with the 'sun' bug, *Eurygaster integriceps*, which has a similar habit of congregating in masses.[3] On the other hand, if the species of assembled coccinellids are beneficial, these could be collected in large quantities from one place and taken to another for liberation into the fields infested with such pests as would form the food of the lady-bird beetles. The latter practice is followed in the mountains and valleys of the Western United States with regard to the Coccinellid *Hippodamia* which feeds on aphids or plant-lice.[4] A few species of *Hippodamia* and of the related genus *Adonia* occur in the Himalayas and it would be valuable to know if any species of these genera assemble in masses in that region.

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Calcutta, *April* 12, 1954.

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CROSSES BETWEEN *BRACON HEBETOR* SAY AND *BRACON BREVICORNIS* WESM. (BRACONIDAE, HYMENOPTERA

THAT there exists some confusion with regard to the identity of the two allied braconids, *Bracon hebetor* Say and *B. brevicornis* Wesm., is evident from a perusal of literature. Detailed examinations of hundreds of specimens of the two species were made for the various morphological characters including genitalia. In addition, attempts were also made at crossing the one species with the other, with a view to establish whether the two species are the same or distinct, and the results are reported here briefly.

Bracon hebetor specimens obtained from pure cultures in the laboratory here, and *B. brevicornis* obtained from I.A.R.I., Delhi, through the kind courtesy of Dr. E. S. Narayanan were used in these experiments. Care was taken to see that males and females of both species were separated as they emerged from pupæ. Unmated males and females of *B. hebetor* were enclosed separately along with the individuals of opposite sex of unmated *B. brevicornis* in 3" × 1" glass vials for about 24 hours to allow time for mating. Then each lot was enclosed in a separate petri dish containing half- to full-grown larvæ of the rice moth, *Corcyra cephalonica* Staint. Egg-laying by the females, larval and pupal development and finally cocoon-formation of the progenies were found to be normal as in the case of *B. hebetor*, or *B. brevicornis*. Progenies of both series of crosses, namely, *B. hebetor* ♀ × *B. brevicornis* ♂ and *B. brevicornis* ♀ × *B. hebetor* ♂ were found to be fertile both when inbred and crossed with pure *hebetor* or *brevicornis*.

The details of these studies together with those on morphological characters to establish the identity of the two species are being published elsewhere.

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Bangalore, *May* 24, 1954.

THE EMBRYO SAC OF *OCHNA SQUARROSA* LINN.

EMBRYOLOGICAL investigations on the family Ochnaceæ have been very little. Schnarf[1] has briefly reviewed the earlier literature on the embryology of a few species of *Ochna*. In the present note an account of the development of female gametophyte of *Ochna squarrosa* is recorded.

The superior apocarpous gynœcium consists of 8-10 carpels, each of which has an anatropous, bitegmic and crassinucellate ovule. A hypodermal archesporial cell gets differentiated just when the integumental initials are laid down (Fig. 1). It soon enlarges and directly functions as the megaspore mother cell (Fig. 2). After the usual meiotic divisions, the megaspore mother cell gives rise to a linear tetrad of megaspores. Of the four megaspores the upper three degenerate and the lowermost develops into the embryo sac (Fig. 3). In the functional megaspore vacuoles make their appearance (Fig. 3). The functional megaspore, during its enlargement, destroys the adjacent nucellar cells (Fig. 3). Its nucleus divides once to form two nuclei which move to the opposite poles by the development of a central vacuole. After two more divisions an eight-nucleate embryo sac of the Polygonum type is formed (Figs. 4, 5).

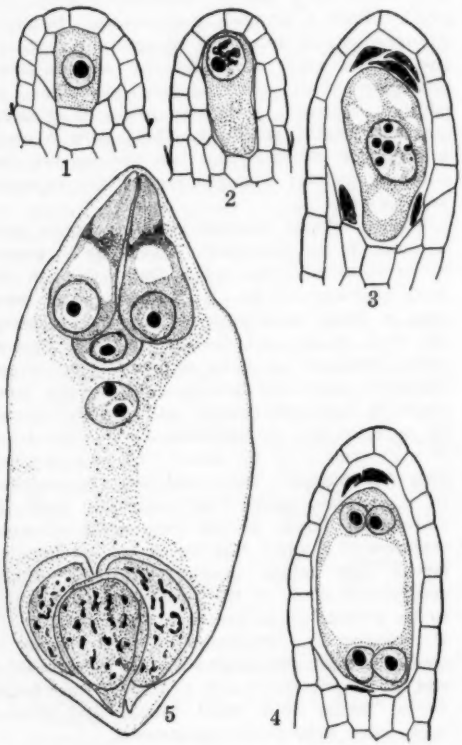

FIG. 1. Portion of nucellus with archesporium, × 970.
FIG. 2. Same at a later stage, × 970.
FIG. 3. Stage showing degenerating and functional megaspores, × 970.
FIG. 4. Four-nucleate embryo sac with degenerated megaspores, × 970.
FIG. 5. Mature embryo sac with its complements, × 679.

In the mature embryo sac the egg apparatus consists of two synergids and an egg (Fig. 5). The synergids show 'filiform apparatus'. The secondary nucleus lies usually near the egg apparatus. The antipodals are very large and their nuclei become hypertrophied (Fig. 5). A detailed account on the embryology of *Ochna squarrosa* will be published elsewhere.

Grateful acknowledgment is made to Dr. S. B. Kausik and Prof. T. S. Mahabale for guidance and suggestions.

Lingaraj College, P. S. CHIKKANNIAH.
Belgaum, *May* 29, 1954.

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TREATMENT OF ROOT TIPS IN PHENOL FOR THE STUDY OF KARYOTYPE

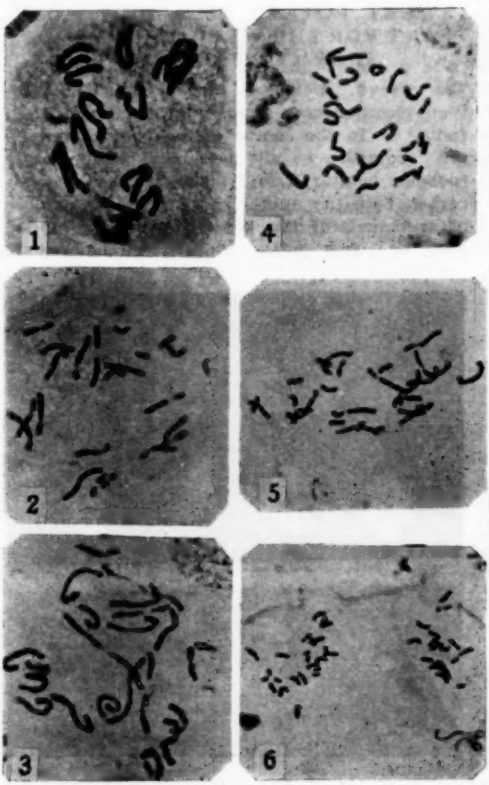
LEVAN AND TJIO[1,2,5] have shown that a large number of chemicals possess the property of inducing chromosome fragmentation.

The present investigation on the study of karyotype is concerned principally with different types of phenols, the fragmentating property of which has been well worked out by Levan and Tjio.[2]

Of all the phenols tested till now, namely, phloroglucinol, resorcinol, hydroquinone, pyrogallol and guaiacol, the first yielded the best results. It may be added that all of them excepting the last one are effective in different degrees in bringing about chromosome structure in details.

The optimal values of the concentrations needed for bringing out the chromosome details have always been found to be lower than the one required for causing extensive fragmentation. The picture revealed looks more or less the same as obtained after oxyquinoline[3,6] and coumarin[4] treatments.

The procedure followed consists in treating the freshly cut root-tips in ·001-·005 M aqueous solution of phloroglucinol for 2½-3 hours at a temperature of 10-15° C. followed by heating till incipient boiling in a mixture of 2 per cent. aceto-orcein and NHCl (in the proportion of 9 : 1) for 5-6 seconds. The material after being sufficiently softened can be smeared in 1 per cent. aceto-orcein solution by applying uniform and heavy pressure over the cover glass with the help of filter-paper put on it. The slides thus prepared can be kept for at least a week by proper sealing and using a moist chamber.



Explanation of photomicrographs from Phloroglucinol-treated cells :—

FIGS. 1—3. Prophase and metaphase stages respectively of *Crinum* sp. showing the condensation in prophase, exaggerated constrictions in metaphase and granulated appearance after prolonged treatment.

FIGS. 4—6. Metaphase and anaphase stages of *Hydrilla* sp., the centromeric granules in Fig. 5 and the spread apart appearance in anaphase in Fig. 6 is to be noted. Magnification, × 900 (approx.)

Viscosity changes of the cytoplasm seem to be brought about by this chemical as worked out in case of oxyquinoline (*vide* Appendix by Stålfelt in Tjio and Levan's paper[6]), and sufficiently spread out metaphase plate, manifesting the chromosome morphology to the minute details, in a single plane (Figs. 2 and 4) can easily be obtained. Contractions of chromosome arms manifested in various degrees in different segments result in a pronounced appearance of the constriction regions, both primary and secondary. The centromeric granules noted by Tjio and Levan[6] after oxyquinoline treatment can also be brought about after this procedure (Fig. 5). The secondary constriction regions become unusually pronounced in some cases. The manifestation of secondary constriction regions thus exhibited in a different way from the rest of the chromosome parts may possibly be attributed to its differentiated nature, both chemical and physical, from any of the chromosome segments. Ample data on this aspect has recently been gathered in our laboratory which will be published shortly.

Prophase stages too show considerable contraction of the chromosome arms thus facilitating the study of chromosome morphology even at this stage (Fig. 1). Spiral structure of chromosomes are revealed in some of the plates (Fig. 5) and even anaphase (Fig. 6)—the later stage shows well scattered chromosomes. With slightly higher concentrations, granulated structure in chromosome segments in late prophase can be noted (Fig. 3).

A detailed report of the work would be published elsewhere.

Cytogenetics Lab., A. K. SHARMA.
Dept. of Botany, N. K. BHATTACHARJEE.
Calcutta University,
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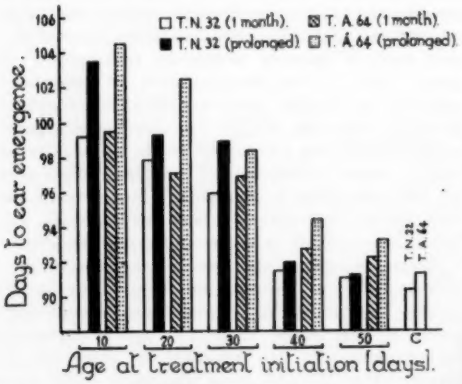
PHOTOPERIODIC RESPONSE IN EARLY VARIETIES OF RICE

THE photoperiodic response of the different varieties or strains of rice growing in various localities of India is greatly varietal in character.[1-8] The present investigation is aimed at finding out the photoperiodic response of two early varieties T.N. 32 (from Baljati of Lucknow

District) and T.A. 64 (from Hansharaj of Unnab District) of Uttar Pradesh. When the seedlings of these varieties were 10, 20, 30, 40 and 50 days old respectively, they were subjected to 10-hour short days (8-00 a.m. to 6-00 p.m.) for a month whereas in other sets of seedlings of the same age groups the same short-day treatment was prolonged till ear emergence. The time taken from sowing to ear emergence of the main shoot under the different short-day treatments is graphically presented in Fig. 1. Short-day photoperiod



brings about a delaying effect in the first panicle emergence in both the varieties. The delay is the greatest when the treatment is applied to the seedlings of 10 days old. As the treatment is commenced with older seedlings of 20, 30, 40 and 50 days there is a gradual lessening of the delaying effect. At every increase of 10 days in the age of the seedling at the time of commencement of the treatment there is a decrease in the mean time of heading by 2·56 days in the range of 10-50 days which is under consideration. Further, the time taken for flowering in the series where the short-day photoperiod is given till the emergence of ears, is always longer than the other series where the photoperiod is limited to a month, irrespective of the age of treated seedlings but the difference seems to be much less when the age of the treated seedlings gets more and more advanced. The two varieties do not give significantly different response.

Grateful thanks are due to Prof. Shri Ranjan for his helpful suggestions and guidance and the facilities provided by him in the Botanical Laboratory of the University of Allahabad for carrying out this piece of investigation and to my colleague, Mr. C. M. Bastia, for the diagram.

Dept. of Botany, Ravenshaw College, Cuttack-3, *June* 7, 1954.

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SWEET POTATO AS A NEW HOST PLANT FOR THE WEEVIL, *ALCIDODES FABRICII*, FABRICIUS

THE weevil, *Alcidodes fabricii* Fabricius, has been recorded on a number of plants in South India.[1-4] In the course of the field studies on the common weevil pest of sweet potato *Ipomœa batatas*, Lam.), namely, *Cylas formicarius*, Fab. the author came across a number of specimens of the Weevil, *Alcidodes fabricii* Fab., on sweet potato crop at Coimbatore. On

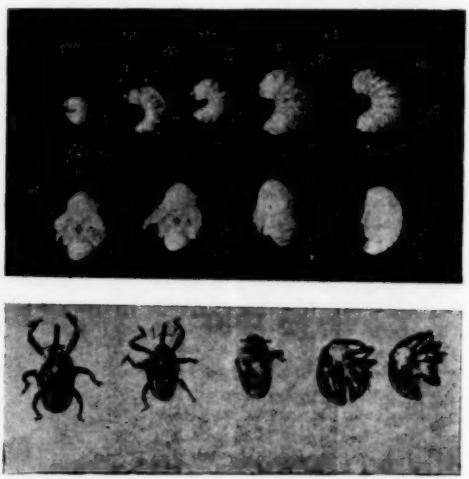

FIG. 1. Stages of the weevil *Alcidodes fabricii* Fabricius.

closer examination, the weevil was found actually breeding inside the capsules of the crop. All the stages of the weevil, were found inside the fruits. This is probably the first time that this weevil is noted on sweet potato crop.

The adult weevil is a medium-sized reddish brown beetle with four longitudinal creamy

stripes on the elytra. Eggs are inserted at the base of the fruit on the stalk and the grubs that hatch out bore from the bottom portion of the fruit and feed on the seeds inside. Pupation takes place inside the capsule itself and the adult weevil emerges out through a hole on the side. Only one grub has been noted in each capsule. The attack is not easily visible from outside as the grubs bore from the bottom and it can be made out only by the small puncture on the stalk of the fruit made by the weevil during oviposition. The adult feeds on flowers. The weevil was noted in larger numbers in some of the seedling types of sweet potato, namely I.B. 22, 52, 54 and 55 than in the local one, since the above varieties flower profusely and set fruits. The detailed study on the biology of this weevil is in progress.

Agricultural College & Research Institute, Coimbatore, *May* 21, 1954. T. R. SUBRAMANIAM.

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THE TEMPORAL REGION IN THE SKULL OF *CHAMAELEON-ZEYLANICUS*-LAURENTI

IT has been now generally accepted that lizards are the modern representatives of the *parapsidian* skull; but since they are on the ladder of 'ascent' their course of evolution is marked by either the appearance or the abortion of one or more fossæ. *Chamæleon zeylanicus* offers a classic example along this line.

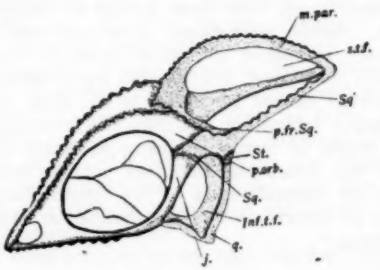

FIG. 1. Lateral view of the skull of *Chamæleon-zeylanicus* Laurenti × 3.

The mode of the formation of the post-temporal vacuity (foramen retro-temporalis of Siebenrock[1]) in chamæleons is quite different from other lacertilians. In *Chamæleon zeylanicus*, though the supra-temporal arcade is much elongated, yet only its beginning part contributes in the formation of the union of the distal end of the *para*-occipital process near the *Condylus cephalicus* of the quadrate and the obliquely directed lateral ridge of the supra-occipital and that such a vacuity is embedded within the supra-temporal vacuity. Thus the position of the post-temporal vacuity is peculiar and perhaps, hitherto unparalleled in the lacertilian studies. The post-temporal fossa is surrounded by the ex-occipital posteriorly, the supra-occipital and the squamosal laterally and the parietal anteriorly. There is no separate post-temporal arcade as for the absence of processus-parietalis here. Although its other constituents, the supra-temporal and the squamosal are present as in other lizards.

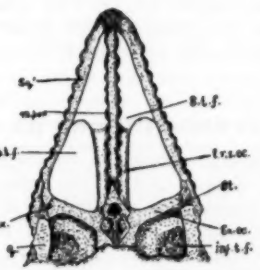

FIG. 2. Posterior view of the skull of *Chamæleon-zeylanicus* Laurenti × 4.

Ex.oc.—Ex-occipital. *inf.t.f.*—Infra temporal fossa, *j.*—Jugal, *l.r.s.oc.*—Lateral ridge of the supra-occipital; *m.par.*—Median process of the parietal, *p.ex.*—Para-occipital process of ex-occipital; *p.fr.sq.*—Post fronto squamosal, *p.orb.*—Post orbital, *q.*—Quadrate, *S.t.f.*—Supra-temporal fossa, *St.*—Supra-temporal; *Sq.*—Squamosal, *Sq'.*—Squamosal extension.

The jugal and the quadrate are widely separated from each other and hence the lower temporal arcade or the infra-temporal arcade atrophies in *Chamæleon* by the loss of the quadrato-jugal, as in rest of the lizards. The infra-temporal vacuity, however, is very large bounded above by the supra-temporal arcade and posteriorly by the quadrate. It is separated from the orbit by an extension of the post-orbital and by the jugal. As the infra-temporal arcade is missing the infra-temporal fossa has no limit below and opens freely.

The presence of a single temporal arcade (supra-temporal arcade) among the three temporal fossæ is worth recording.

I am greatly indebted to Dr. P. N. Mathur for his kind guidance, Principal V. V. John for full facilities and to the Government of India for the award of a scholarship.

Zoology Dept., JAGDISH PRASAD.
Govt. College, Ajmer (India),
March 2 1954.

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THE DIPOLE MOMENT OF INDENE

THE dipole moment of indene is determined in three non-polar solvents—cyclohexane, carbon tetrachloride and carbon disulphide—covering a dielectric constant range of about 2·0-2·6. The dielectric constants of the solutions are determined at a frequency of 3·6 Mcs./Sec. using the heterodyne beat method and a modified dielectric cell of the Sayce and Briscoe type.[1] The experimental observations are treated in the manner discussed by Guggenheim[2] for obtaining the dipole moment values. The results are given in the following table.

TABLE I

Temperature = 31·5° *C.*

Solvent	Dielectric constant of solvent	P_0 c.c.	Dipole moment in Debye units
Cyclohexane	2·0076	14·08	0·84
Carbon tetrachloride	2·2215	14·52	0·85
Carbon disulphide	2·6212	15·79	0·89

It is noted that the orientation polarisation P_0 and hence also the dipole moment increase as the dielectric constant of the medium increases. That is, the compound exhibits a positive solvent effect.

A detailed report of the investigation will be published elsewhere.

Physics Dept., D. V. G. L. NARASIMHA RAO.
Andhra University,
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SYMPOSIUM ON THE CONTROL OF INSECT VECTORS OF DISEASE

THE reliance placed on chemicals during the past decade in the fight against insect vectors of disease and the failure of some of the commonly used insecticides to maintain control of certain species have given rise to complex problems. The nature and significance of these appeared to justify a broad review by a group of experts in order to formulate, so far as was possible, both immediate and long-term plans. In consequence, a symposium on the control of insect vectors of diseases was convened in Europe jointly by the Regional Office for Europe of the World Health Organization and the Instituto Superiore di Sanita, Rome, in October 1953, and was attended by 24 experts from 11 countries with a wide geographical distribution.

Among the suggestions for future orientation of insect-control programmes, the need for basic physiological research on insect resistance was particularly emphasised during the symposium. The areas in which the greatest amount of research appears to be required are the following: (*a*) *General Research*: Expansion of basic research on the physiological mechanisms of intoxication and death for all insecticides in widespread use, development of the necessary microanalytical methods for determining insecticides and their metabolic derivatives in insect tissues, identification and detailed analysis of resistance mechanisms, development of the physiological basis for alternative methods of controlling resistant insects. (*b*) *Specific Laboratory Research*: Studies of the manner in which systemic insecticides are metabolized by the insect body to produce toxic products, studies of how and where DDT is stored in the tissues, development of synergists for protection of new and known insecticides against metabolic breakdown, development of improved insecticides from those groups of compounds (*e.g.*, organic phosphates, pyrethrins and analogues) resistance to which seems to be less readily developed. (*c*) *Specific Field Research*: A survey should be made, in all areas where adequate laboratory facilities are available, of the ability of available strains of Musca to absorb and metabolise DDT, the purpose being to gain an understanding of the relative importance of absorption and metabolism in DDT resistance.

REVIEWS

Advanced Statistical Methods in Biometric Research. By C. Radhakrishna Rao. (John Wiley & Sons), 1952. Pp. xvii + 390. Price £ 3.

The core of this book is its exposition of Mahalanobis' D^2 and of developments of the theory made by Rao himself, which have hitherto been accessible only in published papers. This is contained in the main in the last three of the nine chapters.

In the earlier chapters (Chapters 2 to 7), other statistical methods, derived largely from the work of W. S. Gosset and R. A. Fisher, are expounded with admirable succinctness.

Chapter 1 is a purely mathematical introduction to matrices and quadratic forms. It is a short but clear and useful introduction to the theory, for purposes other than its applications to statistical work. The second chapter brings together a number of classical theorems on the normal distribution of a number of correlated variates, and related distributions. It is a useful work of reference for those who have a good grounding in the subject already.

The section on linear estimation gives a very concise treatment of the formation of normal equations, with extensions suggested by R. C. Bose, and developed by Rao himself in his papers in *Sankhya* in 1945. The methods of maximum likelihood, analysis of variance, the use of χ^2, Student's t, the variance-ratio F, Neyman and Pearson's likelihood test, are dealt with concisely and with a fair number of numerical examples. There are places in the book (for example, in the discussion of tests of independence and of the uses of χ^2 in Chapters 5 and 6 where a number of methods are mentioned with little discussion: but there are adequate references to the literature).

The numerical illustrations are largely (as the title suggests) from biometric measurements; but the methods can be applied to classificatory problems in other fields. There is fairly full discussion of the data in the anthropometric survey of the U.P. contained in the classical paper by Mahalanobis, Majumdar and Rao, in *Sankhya* in 1949, to which Rao contributed the main mathematical parts.

The book is by no means easy reading. Terms and symbols are introduced in a way which will be understood by one familiar with the subject, but must be difficult for a new reader. In some cases, a symbol or a phrase is used but not explained until a little later in the book. The book would gain in value as a general work of reference, and might be suitable at an earlier stage in the study of statistical theory, if there were a table of signs and symbols used. There are a dozen symbols commonly used in the book, but not found in the index.

That Mahalanobis' D^2 and Hotelling's T are effectively equivalent is made clear on pages 73 and 74 of the book, but elsewhere they are discussed in separate sections—which must add to the difficulties of the student.

As Mahalanobis' generalised distant function is so prominent a feature of the book, it is odd to be told (on p. 355) that it is applicable only to groups in which the measurements are normally distributed. Surely, the generalised distance can be used with considerable confidence in many problems where the distribution is known not to be normal; although (as in so many other cases) the theory has been fully worked out only for the normal distribution.

It may seem cavilling, when a book is as a whole so very well printed, to complain about punctuation; but Rao's indifference to punctuation—its total absence from equations—does occasionally leave the meaning of a sentence ambiguous. Among many good printers today, it is the fashion perhaps to use much less punctuation than formerly; and no doubt if the necessary effects can be obtained by spacing, the page will gain in elegance and the exposition in clarity, but in this book the omission or insertion of punctuation is careless: quite often a full stop occurs where a sentence does not end; some commas appear between the factors of a continued product.

Rao's published papers combine a thorough discussion of the abstract logic of statistical methods with descriptions of the mechanical computing programmes necessary for those methods. This unusual quality—for it is a remarkable gift to be able, not only to show what on logical grounds ought to be done, but also how in actual computation it can be done—is abundantly in evidence here also. Even in the first—purely mathematical—chapter there is a description of a computing tech-

nique for calculating a reciprocal matrix. But this high standard of thoroughness has some lapses: for example, we are told (on p. 338) that the problem of finding the best method of the selection of candidates for a number of jobs, on the basis of their scores in some suitably designed tests, admit a neat solution by the use of lemmas in an appendix; but the lemmas depend on the existence of a set of constants whose existence is not proved.

The volume is sure to be widely used not only by those interested in biometric research, but also by a much wider class of statisticians.

W. F. KIBBLE.

Infra Red Absorption Spectra of Steroids—An Atlas. By K. Dobriner, E. R. Katzellinbogen and R. N. Jones. (Interscience Publishers, New York), 1953. Pp. 299. Price $ 11.50.

In recent years, increasing use has been made of the infra red absorption spectrum in general chemical analysis. In the field of steroids, in particular, the infra red spectrum has been used for the purpose of identification and for eliciting information about the functional groups present in a steroid. No two steroids excluding optical isomers, give exactly the same spectrum, and this fact serves as the basis for the use of infra red spectroscopy as a means of identifying steroids. Research workers are often greatly handicapped by the scarcity of published spectra of pure compounds, and the present book takes a great step forward in overcoming this difficulty in the case of steroid hormones, their metabolites and derivatives, steroid alcohols, bile acid esters, steroid sapogenins, cardiac aglycones and steroid alkaloids, by providing a compilation of infra red spectra of about 300 compounds of this class.

The spectra are arranged according to the presence in the compound of groups giving characteristic absorption so as to facilitate comparison of the appropriate spectra with that of an unknown steroid. A short introduction to the book describes the use of the spectra as a method of identification and also includes a discussion of the correlation of absorption frequencies with various structural characteristics. The book contains a bibliography of 48 references to practically all the available literature on the subject.

The spectra, indexed both numerically and alphabetically, have been obtained in solutions in carbon tetrachloride, carbon disulphide or chloroform, employing usually 1 mm. cell and concentrations ranging from 0·01 M to 0·1 M and are shown as plots of percentage absorption against wave number. Each spectrum has been divided into three regions extending over the ranges 1,800 — 1,580 cm.$^{-1}$, 1,480 — 1,300 cm.$^{-1}$ and 1,400 — 650 cm.$^{-1}$, and for each of these regions, different experimental conditions have been employed depending on the absorption characteristic of the solvents and the band intensities. There are also included in the book a few representative spectra in the region 2,600 — 3,800 cm.$^{-1}$ Each spectrum has been allotted a full page and consequently, there is a high degree of fidelity of reproduction of the spectra. There is no doubt that the book will serve as an invaluable aid to research workers in the field of steroids. S. SWAMINATHAN.

Neutron Optics. (*Interscience Tracts on Physics and Astronomy No.* 1.) By D. J. Hughes. (Interscience Publishers, New York), 1954. Pp. vii+136. Price $ 2.50.

These Interscience Tracts prepared under the editorship of Professor R. E. Marshak are intended "to provide non-specialists with authoritative and relatively brief and inexpensive accounts of recent advances in the many specialized branches of physics and astronomy". The monograph under review amply fulfils this aim. It deals with the problem of the scattering of neutrons and its applications to nuclear physics, crystal structure and magnetism. The propagation of neutrons through matter is quite similar to that of electromagnetic waves and one can in fact talk of a complex index of refraction for the neutron waves. They can be reflected, refracted and diffracted. Monochromatic (mono-energetic) neutrons can be produced by crystal reflection as with X-rays, and these can be used in the study of crystal structure. Since the scattering of neutrons is due to the nuclei of atoms and depends primarily on their nuclear structure, it is possible that elements, such as hydrogen, which are poor scatterers for X-rays are strong scatterers for neutrons. Neutrons have therefore been used for finding the position of hydrogen atoms in crystal structures. Again, since neutrons have spin, they can be magnetically scattered, a phenomenon having no counterpart in X-rays. This has enabled a detailed study to be made of the magnetic structure of ferromagnets and antiferromagnets.

There is a fund of information within the hundred and odd pages of this booklet, which should find a place in every physics library. Further numbers in the series will be eagerly awaited.

G. N. RAMACHANDRAN.

Crystal Growth and Dislocations. By Ajit Ram Verma. (Published by Butterworth Scientific Publications, Dist.: Lange, Maxwell & Springer, Ltd., London), 1953. Pp. xii + 182. Price 30 *sh.*

This book deals mainly with the experimental techniques developed during very recent years for the study of crystal growth and the results obtained therefrom. These are of two types, those using phase-contrast microscopy or the method of multiple-beam interferometry, developed in Tolansky's laboratory, and those making use of electron microscopy or electron diffraction. The author himself has obtained interesting new results with the former techniques and naturally therefore these are described in detail and occupy the major portion of the book. As the author states, "For electron microscopic techniques which I could not describe authoritatively, reference may be made elsewhere".

The book is based on the Ph.D. thesis of the author, but it is not merely a reproduction of the thesis. It is well written in a clear brief style omitting all unnecessary detail. Perhaps the only criticism that may be made is that in the portions describing the modern theories of crystal growth (Ch. 2), the author could have devoted a little more space and made the discussion complete in itself, instead of only mentioning the final results of the theory. However, the experimental sections are extremely well written, and the large number of beautiful photographs add much to the value of the book. In the small space of less than 200 pages, Dr. Verma has given a remarkably clear picture of the present state of the subject.

The book is well got up and the reproduction of the large number of figures (mostly photographs) is excellent; however, the price of 30 *sh.* appears to be excessive for a monograph of this size.

G. N. RAMACHANDRAN.

Tables of Lagrangian Coefficients for Sexagesimal Interpolation. (NBS *Applied Mathematics Series* 35.) (Order from the Government Printing Office, Washington 25, D.C.). Pp. 157. Price $ 2.00.

The Lagrangian interpolation formula is a tool of fundamental importance in problems of interpolation. Although many and extensive tables of Lagrangian interpolation coefficients have been provided for decimal subdivisions of the argument, few corresponding tables are available for arguments in sexagesimal measure, such as angles given in units of degrees, minutes and seconds. Even though interpolation is possible, it is a cumbersome operation to find the required coefficients in existing tables.

The present tables are designed to eliminate the need for such repeated interpolation. They should therefore prove to be a very useful tool for workers in fields such as astronomy, geodesy, ballistics, engineering and geography, where data are frequently in units of degrees (or hours), minutes and seconds.

Select Methods of Metallurgical Analysis. (Second Edition, Revised). By W. A. Naish, J. E. Clennell and V. S. Kingswood. (Chapman & Hall), 1953. Pp. xii + 660. Price 75 *sh.* net.

In preparing the second revised edition of the book under review the editor, Mr. Naish had rightly set up an editorial panel. The way in which the vast field of metallurgical analysis right from the sampling of the materials, qualitative detection of the elements and analysis of the ferrous and non-ferrous alloys and some of the important commercial metals have been dealt with cannot but be appreciated by them for whom the book is meant.

The book has been divided into six parts: the first part deals with the sampling of ores, alloys and other metallurgical products, standard methods of solution and separation and qualitative analysis. The importance of correct sampling has been rightly emphasised and different methods of sampling different substances have been dealt with.

Part II of the book deals with selected methods for the analysis of 49 elements. For each of the elements its metallurgical occurrence, source of the element for standards and methods available for determination by gravimetric, volumetric and colorimetric methods along with the theory have been given. This part will be of use to all chemists and help them in choosing the right method of analysis for any of these elements. However, it seems to the reviewer that it would have been better had ionic equations been used instead of the classical ones.

Standard methods for analysing seven commercial metals, non-ferrous alloys and irons, steels and ferro-alloys have been given in detail in the third part of the book. Different methods have been given for the determination of a particular element depending upon the fact whether the element concerned is pre-

sent in the metal or alloy as a major or minor constituent or as an impurity. Apart from gravimetric and volumetric methods, absorptiometric and polarographic methods have also been incorporated wherever these are more accurate or convenient. It is observed that in the case of some of the metals and alloys the limits of the constituents and impurities has been mentioned. It would have been better if the same procedure had been followed for all of them.

In the next two parts of the book the analysis of ores, slags, refractory materials and coal and coke are given. The treatment of the analysis of ores seems to be too brief. No method for determination of sulphur in zinc ores has been given. In the case of determination of sulphur in lead ores (galena) it is written, "Estimate exactly as described in copper ores" (p. 511). But sulphur in lead ores cannot be done exactly by the method given for copper ore (p. 498). This needs correction.

In the sixth and the last part, modern physicochemical methods have been given. When within only 56 pages one has to deal with all the methods including absorptiometry, spectrophotometry, polarography and spectroscopic analysis, the treatment cannot but be too elementary both in theory and technique, and perhaps loses much of its practical utility. Would it not have been better if, instead, only electrometric titrations, calorimetric and absorptiometric methods have been dealt with in greater detail?

On the whole the book is very well-written and will be of great help to those engaged in metallurgical analysis.

T. BANERJEE.
H. P. BHATTACHARJEE.

The Properties of Tin. (Published by the Tin Research Institute, Perivale, Greenford, Middlesex, England), 1954. Pp. 55.

The new edition aims to present all the published atomic and nuclear, physical, physicochemical and metallurgical data concerning pure tin, but does not give data for tin alloys, which are covered in a separate publication of the Institute. The main divisions of the data relate to atomic and nuclear properties, line spectra, X-ray data, crystallography, optical properties, electrical and magnetic properties, thermal properties and mechanical properties.

The book is intended for libraries and research laboratories to whom it will be distributed, free of charge; for private readers there is a charge of 2 shillings and 6 pence in part defrayment only of printing costs.

Organised Industries of India—Cement. By S. L. Sharma. (Universal Publishers, Hozratganj, Lucknow), 1954. Pp. 70. Price Re. 1.

This is a series of booklets designed to meet the needs of businessmen, industrialists, students of economics and commerce and others to keep themselves informed of the economic activities of the country, both in the public and private sectors.

In this pamphlet the author considers the facts of Indian cement industry, its historical development, monopolistic tendencies, government regulation and control and the planning and possibilities of future development. On the basis of available statistics, the author makes several suggestions for the rationalisation of the industry including an interesting one, that in order to meet zonal requirements and for the utilization of locally available raw materials, low cost small-sized units of capacity 10,000-30,000 tons, working with vertical shaft kilns can be pressed into service with advantage. This low-priced booklet provides interesting and stimulating reading.

Selected Values of Physical and Thermodynamic Properties of Hydrocarbons and Related Compounds. By F. D. Rossini, K. S. Pitzer, R. L. Arnett, R. M. Braun and G. C. Pimentel. (Am. Petroleum Institute, Carnegie Press, California Institute of Technology), 1953. Pp. 1050. Price $ 7.00.

This useful and critical compilation of data is an accomplishment of the A.P.I. Research Project 44, and has for its object the provision of basic data and background information of real value in the planning and development of new or improved methods for the discovery, production or refining of petroleum. Several reputed physicists and chemists have cooperated in the programme over a number of years to appraise critically the validity of the selected data on physical and thermodynamic properties, and infra red, Raman and mass spectra data. This volume thus serves as today's standard of physical and thermodynamic data on hydrocarbons.

The physical properties include the following: boiling point and pressure coefficient of boiling point at atmospheric pressure, refractive index, specific gravity, specific dispersion, viscosity, vapour pressures, critical pressures, compressibility factor, surface tension, heat of vapourisation, heat of combustion, heat of formation, entropy, the cryoscopic constants, etc.

The compounds covered in the work, include hydrocarbons of all types and molecular

weights and all non-hydrocarbons of importance to the petroleum industry. The latter include organic sulphur compounds, organic oxygen compounds, simple nitrogen compounds and certain halogens and halogenated compounds. To facilitate use by engineers as well as chemists and physicists, the selected values have been converted to engineering units as appropriate.

In order to keep these compilations uptodate, new tables and revisions are printed on loose leaf sheets and distributed once or more each year. This distribution is gratis to most of the libraries and research organisations of the world.

Fruit From Trained Trees. By Stanley B. Whitehead. (Published by J. M. Dent & Sons, London), 1954. Pp. 151. Price 10 *sh.* 6 *d.*

Modern fruit-growing has undergone revolutionary changes. The advent of selected root stocks of known performance and effect has helped to modify the habit of growth of fruit trees and force them into bearing early and in plenty. This attractively produced little volume on "fruit trees" is unique inasmuch as it deals exclusively with those forms of fruit trees which can be trained to grow within a limited space either in the open or on the walls with a habit of growth that can be easily modelled to encourage consistent and good bearing. It describes in simple and lucid language every aspect of intensive production of fruits from trained trees such as apples, pears, nectarines and peaches, apricots, plums and gages, cherries, figs and currants, gooseberries, brambles and grapes. Although the book deals mainly with the fruits of temperate regions, it provides quite many useful and practical hints to fruit-growers and amateur gardeners in the tropics as well.

The book is divided into 13 chapters. The first chapter describes what a 'trained fruit tree' is, its care and culture, while the second chapter details the planning of modern fruit garden, the choice of its site and soil. In the remaining eleven chapters, each fruit tree is dealt separately, with exhaustive notes on their raising, shaping, culture and harvest. At the end of each chapter, special requirements of individual fruit trees are mentioned with details on pests and diseases and their control measures. Hints regarding the intricacies of pruning of oblique Cordon trees, vertical Córdons and Espaliers, dwarf pyramids and fan-shaped trees, are a special feature. The spraying calendar and the list of recommended varieties for each type of fruit, greatly enhance the value of the book. The inclusion of Appendix on propagational methods of tree fruits and the insecticides and fungicides are definitely of immense help.

The get-up of the book is excellent and it is richly illustrated and includes carefully chosen photographs and informative line drawings. Dr. Stanley B. Whitehead and his publishers are to be congratulated for producing a very fine book for all those "interested in the pleasurable and profitable task of growing delectable fruits in the most modern way".

N. L. Dutt.

Fluorescence Analysis in Ultraviolet Light. By J. A. Radley and J. Grant. (Fourth Edition). (Chapman & Hall), 1954. Pp. xvi + 560. Price 52 *sh.* 6 *d.*

This volume is a revised and enlarged fourth edition of the book first published in 1933. As the third edition was published as early as 1939, the publication of the fourth edition now will be welcomed by all who are interested in fluorescence analysis in ultraviolet light, since during this period, various instruments used in this type of work have been improved and quite an extensive literature has also accumulated on different aspects of the subject.

The book is divided into two parts: in Part One, there are five chapters dealing with the theory and technique of fluorescence analysis. Description of several types of lamps and filters have also been given. In the second part, 20 chapters are devoted to the applications of this technique in different fields. Thus, one chapter each relates to agriculture, bacteriology, botany, constructional materials, drugs, foods and food products, fuels and lubricants, inorganic chemistry, leather and tanning, legal and criminological work, medical and biological science, minerals and gems, museum work, organic chemistry, paints and varnishes, paper and cellulose, rubber, textiles and dyestuffs. Forty-five excellent photographs are also included at the end to illustrate the various applications of fluorescence analysis.

A special feature of the volume under review is the exhaustive list of references collected and given at the end of every chapter. One may perhaps criticise the paragraph heading on p. 233 of vitamin B_5 for nicotinic acid as out of date, which may preferably be omitted in future editions. The authors have drawn

largely on their rich and varied experience of investigations in this particular field, and produced an excellent monograph, which should serve as a standard reference book on all aspects of fluorescence analysis in ultraviolet light.

P. S. SARMA.

The Wealth of India—Industrial Products, Part III: D-E. (Published by the C.S.I.R., New Delhi), 1953. Pp. 250 with 13 plates and 94 text illustrations. Price Rs. 20.

Part III of *Industrial Products* comprises articles beginning with the letters D and E. It includes monographic information on fifty-four industries, some of which have been grouped together under major subject heads. Thus thirteen industries, including radio receivers and components, telegraph and telephone equipment, transformers and wires and cables, are included under the subject Electrical Industries'; fifteen items, including lemongrass oil and sandalwood oil, are included under 'Essential Oils'.

In compiling the articles, an attempt has been made to trace the development of the industries dealt with and to describe their present position; the principal raw materials, their sources and availability are indicated; a description of the manufacturing process is given; and available statistical data are presented. This volume includes also an index to the first three of the series.

This encyclopædic work, planned and produced with much care and labour, is bound to be as well received as its predecessors.

Books Received

The Vitamins, Vol. I. Edited by W. H. Sebrell Jr. and R. S. Harris. (Academic Press, Inc., Pub.), 1954. Pp. xiii+676. Price $ 16.50.

Advances in Carbohydrate Chemistry, Vol. VIII, Edited by C. S. Hudson and M. L. Wolfrom, (Academic Press Inc., Pub.), 1953, Pp. xvii+408, Price $ 10.00.

International Scientific Radio Union. Special Report No. 3. *Discrete Sources of Extra-Terestrial Radio Noise.* (General Secretariat of U.R.S.I. 42 rue des Minimes, Brussels), 1954. Pp. 56. Price 11 *sh.*

The Structures and Reactions of the Aromatic Compounds. By G. M. Badger. (Cambridge University Press), 1954. Pp. xii + 456. Price 63 *sh.*

The Reactivity of Free Radicals—Discussion of the Faraday Society, No. 14. (The Aberdeen University Press), 1953. Pp. 256. Price 35 *sh.*

The Chemistry of Heterocyclic Compounds—Compounds with Condensed Triophene Rings. Vol. 7. By Hartough and S. L. Meisel. (Interscience Publishers, Inc.), 1954. Pp. xv + 515. Price $ 16.50.

The Biochemistry of Brewing. By I. A. Preece. (Macmillan & Co.), 1954. Pp. vii + 393. Price 25 *sh.*

Minerals for the Chemical and Allied Industries. By Sydney J. Johnstone. (Chapman & Hall), 1954. Pp. 692. Price 75 *sh.*

The Moon Puzzle. By N. O. Bergquist. (Grafisk Forlag, Copenhagen, Denmark), 1954. Pp. xiii + 378.

Chemical Engineering. Vol. I. By J. M. Coulson and J. F. Richardson. (Pergoman Press, Ltd., London), 1954. Pp. viii + 370. Price 38 *sh.* 6 *d.*

Electromagnetic Theory. By U. C. A. Ferraro. (The Athlone Press, London. Orient Longmans, Ltd., Madras 2), 1954. Pp. viii+555. Price 42 *sh.*

Handbook of Cosmetic Materials. By Leon A. Greenberg and David Lester. (Interscience Publishers, Inc. Asia Publishing House, Bombay-1). 1954. Pp. xii+455. Price $ 12.50.

Name Reactions in Organic Chemistry. By A. R. Surrey. (Academic Press), 1954. Pp. viii+192. Price $ 4.00.

Advances in Enzymology, Vol. XV. Edited by F. F. Nord. (Interscience Publishers, Inc.), 1954. Pp. x + 547. Price $ 11.00.

Intermediate Zoology. By D. R. Puri. (Published by S. Chand & Co., Fountain, Delhi), 1953. Pp. 441. Price Rs. 9.

Rice Breeding and Genetics. By K. Ramiah with the assistance of M. B. V. N. Rao. (Indian Council of Agricultural Research), 1953. Pp. vii + 360 + 5. Price Rs. 17-8-0 or 27*sh.*

SCIENCE NOTES AND NEWS

Presowing Induction of Sugarcane Setts by Coloured Lights

Sri. M. S. Subba Rao and C. P. Sinha, Central Sugarcane Research Station, Pusa, Bihar, writes as follows:

In an attempt to improve germination percentage, studies were initiated on the effects of various components of white light on the germinating capacity of sugarcane setts. Blue, green, red and white lights were directed on one-budded setts of uniform vigour for 24 hours in wooden boxes. These lights were obtained by wrapping up coloured paper over a 500 watt bulb at a distance of 4'. Twelve setts were treated separately for each plot and they were sown in microplots of 6' × 6' size with four replications.

Amongst different coloured lights green, red, white and blue are helpful to germination in the decreasing order. It was significant to note that green light was most useful for germination, while it is well known that red light is most useful for photosynthesis.

The authors are highly grateful to Sri. K. L. Khanna for his interest and kind encouragement.

Cobalt as a Carcinogen

The possibility of cobalt functioning as a carcinogen has been reported by J. C. Heath in *Nature* (1954, 173, 822).

Some pure 400-mesh cobalt powder was mixed with fowl serum, and a quantity of 0·028 g. cobalt in 0·4 ml. serum was injected into the thigh muscles of rats 2-3 months old of the hooded strain. Ten male and ten female rats were so treated and a further ten male and ten female animals of the same strain and age were similarly injected with fowl serum only. There was little or no reaction immediately after the injection, and nothing was observed up to some five months, when two male rats began to develop tumours at the site of injection. One month later, these tumours measured approximately 3 cm. × 3 cm. and at autopsy were found to be malignant neoplasms.

Thermo-Junction Cooling Unit

In the past little use has been made of the Peltier cooling effect, which occurs when an electric current flows through the junction between two different metals, in the appropriate direction. At the Royal Society's Conversazione held recently, a demonstration was given of a semi-conductor thermo-junction which, it is claimed, will give a cooling effect of nearly 50° F. New semi-conductor materials are being developed which are expected to make still larger cooling effects possible. Success appears to depend upon the production of materials with high electrical conductivity and low thermal conductivity, as the Peltier cooling effect is usually much less than the heating effect in the junction because of its own resistance.

At the Conversazione, a unit employing bismuth and a bismuth-tellurium compound was demonstrated which produced miniature ice-cubes, but at present this efficiency is certainly much less than that of conventional motor-driven refrigerators.

German Developments in Plastics and Synthetic Rubber

Abstracts of recent German patent applications on new processes and products in the field of plastics and elastomers are offered in a new bulletin issued by *Research Information Service*, 53, Nassau Street, New York 38, N.Y. Translations of all these patent applications can be obtained in the form of RIS Reports at the prices indicated in Bulletin No. 87—*Plastics and Synthetic Rubber.*

The variety of subjects covered by these reports is suggested by the subdivisions of the Bulletin: elastomers; vinyl and ethylene polymers; acrylics, phenolics, alkyds and polyesters; plasticizers and miscellaneous products and processes.

Construction of Laboratory Apparatus for Schools

UNESCO has brought out a portfolio of eighty drawings of scientific equipment, intended primarily for manufacturers but suitable also for school workshops. They include complete lists of materials required for each item, exact specifications for each part, and instructions for assembly, together with brief indications of the purpose of each item in school use. The combination of the drawing with the specifications and instructions will enable trained workmen to produce school apparatus equal to the best.

There are two series of drawings in the portfolio—one includes the minimum equipment needed for the successful teaching of what is called "general science" in elementary schools and in lower secondary schools; the second includes equipment for more advanced instruction in the more specialized courses in physics, chemistry and biology in secondary schools. The various items are arranged by scientific subjects. The portfolio is bilingual (English and French) and is priced at $8.00.

Napier Shaw Memorial Prize

The Royal Meteorological Society announces the first competition for the Napier Shaw Prize of £ 100. On this occasion it will be awarded to the author of the best original essay in English on 'The Energetics of the General Circulation'. The competition is open to all nationalities, and essays must be presented before 4th March 1956. Details of the competition may be obtained from the Assistant Secretary, Royal Meteorological Society, 49, Cromwell Road, S.W. 7.

International Biological Abstracts

Dr. Jacob Chandy, Department of Neurology and Neuro-surgery, Christian Medical College Hospital, Vellore, S. India, has kindly consented to edit and forward abstracts of articles from *Current Science* for inclusion in the *International Biological Abstracts*. It would be helpful if abstracts of relevant articles are sent to Dr. Chandy soon after their publication in *Current Science*.

Indian Botanical Society

At a meeting of the members of the Indian Botanical Society residing in and around Dehra Dun held recently, it was decided to start a local branch of the Society with the object of promoting the cause of botany in all its aspects. Dr. K. A. Chowdhury and Mr. M. B. Raizada were elected President and Secretary of the local Branch.

Dr. S. L. Hora

Dr. Sunder Lal Hora, Director, Zoological Survey of India, has been appointed as Fish and Wild Life Adviser to the Damodar Valley Corporation with effect from 15th July 1954, for a period of two years. He is also Honorary Secretary-General, Indian Board for Wild Life and Fish Consultant to the Food and Agricultural Organisation of United Nations.

Kalinga Prize Award, 1954

Mr. Waldemar Kæmpffert, science editor of the *New York Times*, has been elected to receive the 1954 Kalinga Prize, awarded annually by the UNESCO for distinguished science writing. The award will be made by Dr. Luther Evans, Director-General of UNESCO, at a ceremony to be held in Paris in September.

Waldemar Kæmpffert has been science editor of the *New York Times* since 1927, and for a quarter of a century has written many editorials and reviews of scientific books for the *Times* and a large number of special articles in American weekly and monthly magazines. His books include: *The New Art of Flying, the ABC of Radio, Invention and Society, Science Today and Tomorrow* and *Explorations in Science*.

Fourth World Forestry Congress

The Fourth World Forestry Congress (with which is incorporated the World Tropical Silviculture Congress) is due to be held at Dehra Dun from 11th to 22nd December 1954. This Congress, which is essentially held for technical discussion, will devote special attention to Tropical Forestry. India is to be the host country, and a special number of the *Indian Forester* will be issued in honour of the occasion. Contributions are invited from foresters all over India so as to make the number a success. The articles need not be elaborate: what is required is a simple statement of the actual research work done or any new observations made by foresters in the field and the conclusions, tentative or otherwise, drawn or indications obtained from them. Such contributions may be sent to the Honorary Editor, *Indian Forester*, New Forest P.O., Dehra Dun.

Symposium on Indian Essential Oils and Aromatic Chemicals

A symposium on research and development in Indian essential oils and aromatic chemicals will be held on September 27-30, 1954, at the Forest Research Institute and Colleges, Dehra Dun, under the joint auspices of the Forest Research Institute and Colleges and Essential Oils Committee of the CSIR. Persons desirous of participating in and contributing papers to the symposium may kindly address Dr. Sadgopal, Secretary of the Organizing Committee, for further particulars.

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